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THE DANGERS OF ELECTRIC LIGHTING.

"THE inquiry was adjourned for a few days to give the jury an opportunity of inspecting the premises and apparatus." Such was the ending of a newspaper report of the fatal accident caused either directly or indirectly by the Grosvenor Gallery electric lighting installation on the 3rd inst. All the particulars which we have as yet been able to gather are to be found in our other columns, and although we cannot, under the circumstances, give our own opinion of the actual cause of the victim's death, we are at liberty to make a few observations on a case which has terminated so sadly.

In the first place, it certainly appears odd that in a shop supplied from the Grosvenor Gallery with the electric light there was nobody present who knew how to cut off the supply of current. Had no instructions been given to the consumer as to what course he should pursue, not merely when he wished to extinguish his lights, but also in case of a recurrence of the little mishaps to which, if all accounts be true, the Grosvenor Gallery and the premises in connection therewith have of late been subject? If this should turn out to be the case then somebody is to blame, and, on the other hand, if attempts had been previously made to cut off the supply and had failed, we can only conclude that the apparatus and its connecting wires had been improperly set up. In either case the responsibility rests with the supplier.

Respecting the advice which ended in the sacrifice of a human life we have little to say. To nine people out of ten unacquainted with the nature of electric lighting installations, the thought of cutting the wires would most naturally occur, and Mr. Davis acted no more indiscreetly than would the majority of men placed in a similar position and with but an instant in which to arrive at a decision. The dangerously rash act was done on the spur of the moment with a result which Mr. Davis little anticipated, and it is high time that those who entertain notions of trying electric lighting in their establishment should be made aware of the consequences of inadvertently meddling with apparatus with which they have not the remotest acquaintance. Yet in such a case as this, with the belief strongly impressed upon one's mind that the house is in imminent danger of bursting into flames, the expedient adopted is the one which primarily suggests itself to the non-technical householder.

The evidence of the medical man, who was quite satisfied that the cause of death was not due to a shock, is not altogether to be accepted without protest. Upon what grounds did he base his decision? It is well known that some deaths which have unfortunately been traced to the effects of an electric shock have been of an instantaneous nature, and who is to say that poor Richard Grove met his fate directly from the fall of 60 feet? It is certain that either occurrence may have been sufficient to cause death, and it is but natural that the verdict of the doctor should be in accordance with the outward and visible signs upon the lad's body, although these may have been quite misleading.

The engineer in the service of Sir Coutts Lindsay, who was examined during the progress of the inquiry, appears to have hazy notions, to say the least of it, regarding the nature of the unseen forces with which he has to deal. Is he not aware that in the majority of cases in which people have come by their deaths in connection with electrical machinery, the "leakage to earth" has been the means of hurling them into eternity? Why should not one get as violent a shock from a conductor and earth as between two wires, if the difference of potential between the points touched is the same?

Whatever the verdict of the jury may be, the occurrence is an extremely unfortunate one. No one, however, will be disposed to think otherwise than that the poor lad's precipitation from the roof to the cellar of the house was indirectly caused by his being upset by an electrical shock, the severity of which will never be known.

The circumstance is not calculated to increase one's confidence in the employment of secondary generators, nor does it quite support the assertion so often made by M. Gaulard that no danger is to be apprehended from the primary circuit of a system of transformers because it is always *metallically closed*. We have combated this absurdity *ad nauseam*, and perhaps the fatal accident upon which we have commented may lead to a modification of the views, shared by others besides M. Gaulard, that no risk is incurred by the use of these inductional apparatus.

The circumstances of the case demand that an explanation should be forthcoming from those supplying the electric light on this system as to the reason why such vagaries as have recently been brought to our notice should crop up and be allowed to remain unchecked. We have been under the impression that the exclusion of the Gaulard-Gibbs apparatus from the Grosvenor Gallery would possibly allow everything to jog along merrily; such, however, does not appear to be the case.

Electrical Transmission of Power in Valencia.—An electric light and power company in Valencia is advocating a project for supplying electrical energy to that town from a distance of thirty-three miles. According to the statement of *Industries*' Madrid correspondent, the motive power is to be supplied by the river Turia, the generating station being established at Chulillas; the total power available is estimated at close upon 3,000 H.P. At the generating station turbines and dynamos would be employed, and the electrical energy actually available at Valencia is estimated at about 1,400 H.P., which would be distributed throughout the town for lighting and motive power purposes.

TELEGRAPH TARIFFS.

(*Continued from page* 10.)

M. ZINCKENS combats this opinion and advances as an argument the effect which the Federal Law of October 1st, 1877, even at the present moment appears to produce as regards the development of internal telegraphy in Switzerland. Statistics certainly show that in 1884 there were 393,584 fewer internal telegrams deposited at Swiss offices than in 1876. But can the raising of tariffs be alone accused of having caused this unfortunate result? We think not, and among the causes which have operated in the same direction as the raising of tariffs, we must include the competition which the telegraph has met with from the telephone. We are strengthened in this opinion by the fact that the number of international telegrams passing through Switzerland was doubled from 1878 to 1884, whilst the internal traffic decreased in the three consecutive years 1883, 1884, 1885, to the extent of about 40,000 telegrams. From 1868 to 1877 the number of internal telegrams in this country increased to an extraordinary extent. This increase was principally due to the reduction of 50 per cent. in the tariffs decreed by the Federal Law of December 18th, 1867. But it is important that we should not neglect to take into account the exceptional increase in the number of offices during the same period. On the 1st January, 1878, there were 1,080 offices open, whilst at the end of 1866 there were only 285. From the 1st January, 1878, to the 31st December, 1884, there were only 134 new offices opened—an average of 15 per year.

When the Swiss Administration raised its internal tariffs in 1877 it was very close to attaining the maximum development which its system was capable of, and it found itself face to face with a public accustomed, from the earliest days of telegraphy, to the possession of the lowest tariff in Europe. Owing to this exceptional situation the reaction was of necessity violent; but it must be remembered that where these same causes do not exist, such results are not to be feared.

Besides, to decide that there is really a halt in the development of telegraphy, it must be ascertained if *the number of persons who resort to the telegraph has diminished*, and not if *those accustomed to this mode of correspondence have sent fewer telegrams*. If statistics could give us information on this, the most interesting point of all, we should probably learn that an Administration which raises its tariffs sufficiently to cover its expenses, does not lose any of its customers, rather, that these will increase; we shall find that the regular senders will despatch fewer telegrams.

Before treating of the measures which may hereafter assist to promote the employment of the telegraph, we must reply to M. Zinckens as to the decrease of the expenses of maintenance in the case of a falling-off in the number of telegrams.

We have said that the fact must not be lost sight of that if the gross receipts are less when the number of telegrams decreases to the extent of 35 per cent., the expenses of maintenance will diminish in the same proportion. M. Zinckens can scarcely believe that this remark is seriously intended. We willingly admit that during the first year, an Administration which has experienced a decrease in its traffic cannot reduce its expenses on the same scale. It can only economise in the printing, supplies and porterage. If, as in Belgium,* the porterage is an important factor in the expense per telegram, a large saving in this respect can be made. During the following year, however, there will be a change; there will be a decrease of expenditure in labour, for as vacancies occur in the staff they will remain unfilled, and thus by degrees the decrease in maintenance expenses will very nearly be proportional to the decrease of traffic.

* In Belgium the delivery of telegrams by a porter in the Telegraph Service costs the Administration an average of 10 centimes per telegram.

Perhaps figures will lend some strength to our views:—In 1876, 2,118,373 internal telegrams, and 800,485 international, were accepted by the Swiss offices, making a total of 2,918,858 telegrams. The expenses amounted to 1,854,208 francs. In 1879 the internal telegrams were 1,679,831 and the international traffic 862,503. The expenses amounted to 1,629,368 francs. We see that the decrease in the number of telegrams is 12·8 per cent., and in the expenditure 12·1 per cent.

We have already referred to certain means by which the telegraph might be brought into more general use without its being worked at a loss.

These means, simple enough, are but insufficiently made use of. We speak of the simplification of administrative formalities and of the increase in the number of offices.

We know that official regulations result in delays and obstacles, and that these are synonymous with costliness.

We also know that if in many countries the cost of internal telegraphy is so great that the tariffs charged do not cover it, it is partly on account of formalities and precautions more or less useful.

Every step which can be taken towards reducing administrative formalities to their most simple form must be favourable to the increase of revenue and the development of traffic, for the less the institution appears mysterious and complicated in the eyes of the public the more the latter will appreciate it.

We have remarked that the enormous increase in the Swiss internal traffic between 1868 and 1876 was as much the effect of increasing the number of offices as of the lowering of rates.

In Germany, from 1876 to 1884, the number of offices increased in about the proportion of 90 per cent. and the telegrams 70 per cent.

In 1874, 574 Belgian offices connected with 22,786 foreign offices had an international traffic of 900,250 telegrams. In 1884 Belgium possessed 885 offices connected with 50,000 foreign offices. The international traffic amounted to 1,796,462 telegrams.

If we suppose that the number of offices had remained stationary from 1874, and that the lowering of rates had been more pronounced, is it likely that such an enormous increase of traffic would have occurred? We doubt it. What does it matter to persons living at a great distance from a telegraph station that a very low tariff exists? They cannot benefit by it.

We are firm in our opinion that the lowering of tariffs alone will not lead to the development of telegraphy, and that the true method of bringing the population to make more frequent use of the telegraph is to establish as many offices as possible, and to unite the rural districts with one another and with the chief district stations.

In Belgium there is an office per 33 square kilometres of land, and per 6,390 inhabitants; in Germany per 44 square kilometres, and per 3,625 inhabitants; in France per 66 square kilometres, and per 4,701 inhabitants; and in Holland per 59 square kilometres and per 7,612 inhabitants.

RECENT ADVANCES AND IMPROVEMENTS IN THE APPLICATION OF ELECTRICITY TO RAILWAY WORKING.

TYER'S TRAIN TABLET SYSTEM.

(*Continued from page* 633, *Vol.* 19.)

WE will now take fig. 3, the *commutator*. This consists of three parts—the commutator proper, by which either positive or negative currents are sent to line on the depression of the bell plunger; the indicating disc, and the electrical and mechanical arrangements for locking the commutator. The commutator, fig. 3, is capable of being turned in one direction only, from

left to right, and each successive inversion of the current is effected by a quarter turn. A is a brass disc rotating on an axle, B, provided with four pins, C^1, C^2, C^3, C^4, and two projecting plates, D^1, D^2, as shown in the figure. The rim of the disc is notched at F^1, F^2. Three brass strips, L^1, E and E^1, fitted with contact studs, and five, marked E^2, +, −, L, and L^2, fitted with contact springs, are arranged parallel with the disc. The + and − strips are connected to the poles of the batteries indicated by the signs. L is joined through the instrument to line, and E, in like manner, to "earth." Thus L and E are for incoming currents. L^1 and L^2 are connected together by a strap, and, on the depression of the plunger, with line. E^1 and E^2 are similarly connected by a strap, and ultimately to earth. Thus L^1, L^2, E^1, and E^2, are for outgoing currents.

In the normal state—the indicator disc showing "in"—the arrangement is as illustrated in the figure. L and E are in contact, + and L^1 in contact, and − and E^1 in contact. The instrument being thus in a position to receive any current from a distant station, and to transmit positive currents only.

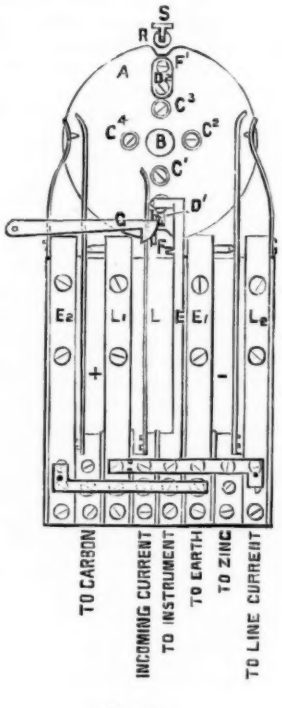


FIG. 3.

Above the disc is arranged a small insulated roller, R. This roller is fixed at the end of a contact spring which, when the disc is as shown, rests upon a metal stud—not shown. This spring and its stud are in the circuit of the "upper disc," and "main slide coils" (to be described later on). On beginning to turn the commutator the roller rises out of the notch. Contact between it and its contact stud is severed and remains so, not only during the quarter turn of the disc to "out," but until the "in" signal is reached at the end of the half turn. This quarter turn therefore disconnects the circuit for incoming currents through the upper disc and slide coils.

On commencing to turn the commutator, C^1 presses against L and causes it to break contact with E. Still pressing upon it L is thrust back until it is caught by G, where it remains after C^1 has passed. This completely disconnects the circuit so that no current can be received during the operation of turning the commutator. The spring, L, is only released from G by the depression of the bell plunger, which of course is only worked in accordance with the code of instructions.

So far we have followed the action of the commutator to the point where C^1 has passed beyond L. We must now follow the movement of the boss or plate, D^1. The figure will make it clear, that on completing the quarter movement D^1 will press upon the + spring, carry it away from L^1, and then place it in contact with E^2. In like manner D^2 has carried the − spring away from E^1 and forced it into contact with L^2.

The instrument is now in a position to receive currents to the bell only, and send negative currents to the distant station. The indication obtained by this quarter movement is that of "out." To produce the "in" indication a further quarter turn must be made. This will bring the disc, A, absolutely in the reverse position to that shown, but practically the same, the contacts in each instance being restored as seen in the figure.

The indicating disc is a visual signal, indicating, first, when it shows "in," that there is no tablet out, or, when the disc shows "out," that the commutator has been placed in position for leave to be given to the distant station to withdraw a tablet; and in the second place, that the lid of the tablet cylinder should be unlocked, so that the tablet from the distant station may, on arrival, be deposited within it in due course. This unlocking is effected mechanically by a boss at the back of the indicating disc, immediately behind the word "out," which on turning the disc displaces a lever, thereby raising a detent which otherwise locks the lid.

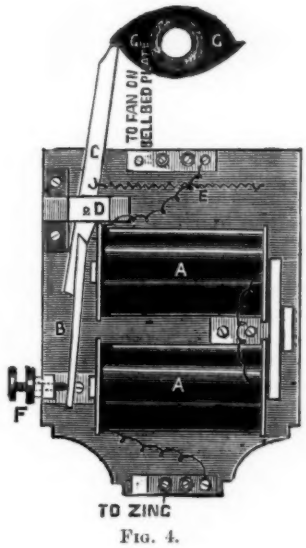


FIG. 4.

The locking arrangements at the left hand end of the commutator axle are of two kinds—the electrical portion, controlled by the distant station and retaining the indicating disc to the signal "in," and the mechanical portion, which, when leave has been given to turn the commutator to "out," locks it until the tablet, withdrawn at the distant station, has been received and deposited within the home cylinder.

The electrical portion, fig. 4, is actuated by the locking coils, A, A, through which a local current is sent whenever the distant station sends a continuous current through the bell and relay. To the armature, B, of these coils is connected, rigidly, a brass lever, C, moving on an axle at D.

The armature rests, normally, as shown in the figures, under the influence of the helical spring, E, and the adjusting screw, F. Attached to the axle of the commutator and rotating with it, is a cam, G; and we see that the lever, C, when in its normal position, rests with its far end just underneath the projecting portion of the cam, and obviously when in this position the commutator cannot be turned. When, however, a cur-

rent is passed through A, A, C is thrown back free from G, when the commutator can be moved one quarter round till the "indicating disc" shows "out." The mechanical portion comes into operation when the "indicating disc" is turned to the signal "out."

Behind the cam, and on the same commutator axle is a brass disc with two pins screwed in at right angles to it and at opposite ends of a diameter. When the commutator is being turned, one of these pins raises a lever, thereby bringing forward a detent which engages with the second pin as soon as the commutator has reached the position "out." This detent is not liberated until the tablet—having been received from the distant cabin—is deposited in the receiver of the instrument, the bottom or pan of which in falling operates on a sliding connecting rod, and releases the detent.

The descent of the pan, while thus releasing the detent, brings under the first pin another rocking lever, which locks the commutator until the pan has returned to its normal horizontal position. When the tablet has passed from the receiver into the cylinder, the signalman can turn the commutator another quarter—to the signal "in," where it again becomes locked. The lid of the receiver becomes locked at the same moment.

The *Locking Apparatus*.—This, as will be seen in fig. 1, consists of an iron plate, sliding in a groove under the main cylinder in which are the tablets one above the other. It is recessed in that part which, when the slide is at home, is concentric with the cylinder, to a depth and size sufficient to receive one tablet, so that when the slide is drawn out it carries with it *one tablet only*, all the remaining tablets sliding over the plane surface. This tablet being removed and the slide returned, the next lowest of the remaining tablets falls into the recess, ready to be drawn out in due course. To prevent the slide being drawn out when there is no tablet in the cylinder—or none between the slide and the last subsidiary slide—a spring catch is placed underneath it which locks it back till depressed by the weight of a tablet.

Let us now assume that permission has been given to withdraw a tablet. The slide being unlocked, the first operation is to raise the check ring—seen to the left of fig. 1. This ring carries a rod which, under the influence of a spiral spring, is normally kept down, as shown in the fig., the other end fitting into one of two corresponding holes in the slide, whether the slide be in or out. If the slide is not fully in, the next tablet in the cylinder will not fall. There are other checks which render it necessary that the action of the signalman should be complete, and that everything done should be carried home into its proper place before the next step can be taken. Thus, whether the slide be in or out, a pawl of the main slide locking apparatus may be pressed so tightly against a ratchet that the electro-magnet will be unable to liberate it, and the unlocking cannot be accomplished. These ratchets are consequently so arranged that when the check ring rod has dropped into either of the holes, the pawls are kept free from the ratchets. This is insured by the check ring rod being caused, by means of an insulated ebonite disc fixed to it, to operate a contact spring in the circuit of the "upper disc" and "main slide coils." Contact being broken except where the rod has dropped into one of the two holes.

This main slide also acts on two vertical springs, against which it presses when home. The left-hand spring is in the circuit of the "commutator locking coils." When the slide is home the circuit is complete; but when the slide has been drawn out the commutator of the instrument cannot be worked: it is locked so long as the slide is not fully home. The right-hand contact spring is in the earth circuit of the outgoing current. When the slide is home, one of the poles of the local battery is connected with earth. When out, this pole is diverted through another contact in connection with the upper disc (fig. 1), and the connection is complete to earth, or not, according as the upper disc indicates "out" or "in."

On the right-hand side of the main slide, two sets of ratchets are fixed parallel to each other, but with teeth in opposite directions; the object being to check any unauthorised movement of the slide, either in or out. Immediately above are two sets of pawls working on one and the same axle. These pawls are acted on by an oscillating polarised armature working in connection with two electro-magnets.

The two coils of one electro-magnet are called "magnetising coils," and the two coils of the other the "line coils." The former are in connection with the local battery—the circuit through them being completed by every depression of the switch plunger—and as the current from this battery always circulates in one direction, the steel cores of the magnet are re-magnetised upon every depression of the plunger and thereby retain their magnetism. The latter are arranged to be brought into the main circuit by the depression of the "switch" plunger, which diverts the incoming current from the bell to the relays (figs. 1 and 2), and hence its polarity is dependent upon the position of the commutator at the distant station. When the distant station's commutator is turned to show the signal "out," and a current is sent, the current being, as explained, diverted from the bell to the relays, causes the front pawl to be raised and the back lowered, so that the main slide can be drawn out, but not put in. The same current in passing through the "upper disc coils" raises the signal "out," indicating that permission has been given to take out the tablet, or, in other words, draw out the main slide which contains it. And in like manner when the commutator of the distant instrument is turned to "in," and a current transmitted, the back pawl is raised and the front one lowered. When this is so the home upper disc will indicate in, and then the slide may be pushed in.

The upper disc coils consist of four coils for two electro-magnets, one pair in circuit with the local battery and the coils of the main slide locking apparatus, whilst the other pair is in the line circuit corresponding with the other pair of the same apparatus. Currents are sent through these coils in the same manner as for the main slide coils. By means of an oscillating polarised armature, a disc carrying the inscription "out," "in," is moved to the right or left. Attached to this disc is an elongated arm, with a contact piece at the end. This, when the main slide is drawn out, is connected through the brass bedplate to the right one of the two vertical springs mentioned in the description of the main slide. When the disc indicates "out" this arm makes contact with its stud, which is connected to earth. When the disc shows "in" this earth connection is broken.

The bell plunger (J, fig. 1) has four functions:—

1. Each depression disconnects the line from the home apparatus, and, according to the position of the commutator, sends positive or negative currents to line.
2. When the commutator is turned to "in" by keeping the plunger depressed the distant commutator is unlocked.
3. When the "switch" plunger at the distant station is held down, each depression of the plunger transmits a current through the distant "main slide" and "upper disc" coils.

After turning the commutator the first depression of the bell plunger raises the detent referred to in the description of the commutator and restores the line circuit.

The switch plunger (I, fig. 1) has two functions:—

1. Each depression sends a current from the local battery through the "main slide" and "upper disc" magnetising coils, always in one direction.
2. When held down at the time an incoming current is being sent by the depression of the bell plunger at the distant station, such current is diverted from the bell relay to the "upper disc" and "main slide" coils.

The galvanometer is in circuit with the line wire, and its object is to indicate when a current is passing. When the bell plunger is being held down in order to unlock the distant commutator, the needle shows a permanent deflection; but as the operation of turning

the distant commutator disconnects the line, the sudden return of the needle to zero indicates to the signalman the fact that this is being done. The bell plunger is then let go, and the switch plunger held down to receive the incoming current and send it through the upper disc and main slide coils. The absence of any deflection when a current is passing of course indicates that something is wrong—as, for instance, when the main slide has not been pushed home.

The battery employed is the No. 2 Leclanché. Twelve to twenty-four cells are required, according to mileage and resistance. Separate batteries should be employed for each set of apparatus. It is, moreover, recommended that whenever more than 12 cells are used they should be divided, 12 cells being used for the line and 12 for the local circuit.

With a view to good and satisfactory maintenance it is desirable that the instrument should be regularly inspected and dusted, and the contact points cleaned; screws tightened and adjusted, and the main slide slightly oiled. Care should also be taken to see that the pawls of the main slide locking apparatus move freely on their axle, and that the teeth of the ratchets have not been broken.

Having now described the working parts of the apparatus, together with their several objects and duties, we will, in our next, follow its practical operation for signalling trains.

THE ELECTRICAL TRANSMISSION OF POWER TO A DISTANCE.

THE question of the transmission of power to a distance has lately made a great stir both in the scientific world and amongst the general public, and M. Hippolyte Fontaine's recent experiments introduce a fresh element into the study of this interesting problem; the results of these experiments were given in the ELECTRICAL REVIEW for November 5th last.

Without being able to fix the date of the real origin of the idea of transmitting motive force electrically to a distance, writes M. Hospitalier in *La Nature*—it was, in fact, realised in Wheatstone's telegraph with magnetic transmitter—we must go back to the year 1873 for the first experiment made specially with this object at the Vienna Exhibition. This is how M. Hippolyte Fontaine, the experimenter, describes it in the *Revue Industrielle* for 1873 (p. 658):—

> The Gramme machines at Vienna have been subjected to an experiment which may one day have very important applications. The first machine was worked by a gas motor, and the electricity produced was sent into a second machine, which actuated a little centrifugal pump. As we had no measuring apparatus, we were unable to determine the available effect; but these preliminary experiments demonstrated not only the possibility of transmitting power to a long distance, but also showed that the rendering was appreciably greater than when other apparatus were employed.

M. Hippolyte Fontaine estimates that the power transmitted was $\frac{1}{3}$ of a horse-power and the resistance about 7 ohms.

From this time the transmission of power was a settled fact.

M. Fontaine also gave the following account before the French Physical Society (at the sitting of December 3rd, 1886) of the progress of this branch of industry, then in its infancy:—

> At Philadelphia, in 1876, the Gramme Company gave an exhibition of the transmission of from 2 to 3 horse-power, passing through a resistance of 20 ohms.
>
> At Paris, in 1878, the same company exhibited an actual distribution of power; one generator worked, either simultaneously or separately, a pump, a ventilator, and a printing press.
>
> All these public exhibitions, however, did not succeed in attracting the attention of manufacturers to this new mode of transport; it was not until the remarkable experiments in performing agricultural operations by means of electricity, undertaken at Sermaize in 1879 by Messrs. Chrétien and Félix, that the subject entered into the domain of industrial practice. The Gramme machines employed by Messrs. Chrétien and Félix turned at 1,400 revolutions per minute and produced a current of about 20 ampères at 400 volts.
>
> Since 1879, industrial applications have multiplied rapidly, and at the Electrical Exhibition of 1881 no fewer than 50 machines were employed in electrical transmission.

Since the Exhibition of 1881, innumerable applications have been made in different parts, always with the aid of Gramme machines, or machines derived from the Gramme type, with the object of transmitting moderate powers to moderate distances.

The difficulty increases with the distance, or, more correctly, with the resistance of the line connecting the generators with the receivers. In order, therefore, not to expend all the energy on the line, the current must be reduced and the initial tension increased, as Messrs. Thomson and Houston had shown, in 1879, in the *Journal of the Franklin Institute* (January, 1879).

After having clearly shown the necessity for the employment of these high tensions Messrs. Thomson and Houston conclude with the following observations:—

> Apart from theoretical considerations, the important fact remains, that with a line very limited in section an enormous mechanical power can be transmitted to a considerable distance. The combustion of coal at the mine and the transport of the mechanical power produced by rivers can therefore be considered as applicable, but it must be borne in mind that there will be an almost inevitable loss of 50 per cent.

This estimate of 50 per cent. is worthy of note, since it has been proved correct, within a very little, in the greater number of the experiments made up to the present, and has not been appreciably exceeded.

But Messrs. Thomson and Houston's error, to which we think it worth while to draw attention, as it is very generally shared, relates to the utilisation at a distance of rivers, waterfalls, in a word, of natural forces, and our opinion on this point agrees with that of M. Hippolyte Fontaine, who may certainly be credited with a certain practical knowledge of the subject. We quote his opinion:—

> M. Hippolyte Fontaine does not think that the utilisation at a distance of waterfalls is as advantageous as we are led to believe. Taking into account the expenses of the installation, of hydraulic motors and dynamos, of the construction of dams, of canalisation, of maintenance, the interest of the capital sunk in it, the rendering of the dynamos, &c., &c.,* we soon arrive at a total expenditure exceeding that occasioned by a steam engine of the same power, especially when we take into account the price of the fall itself, which is rarely without an owner. The question considered from the point of view of transmissions is quite different. In this case, the intervention of electricity offers numerous advantages over the systems now in use.

It may be asked why the experiments we are about to describe were undertaken, since their originator himself did not believe in their industrial success. One more extract from his communication will explain this:—

> If M. Hippolyte Fontaine has undertaken fresh experiments on the transmission of force to a great distance, it is only in order to show that the machines invented and constructed by M. Gramme are lighter, less expensive, and better in every respect than those recently experimented upon at the Chemin de Fer du Nord."

With these reservations, and we see how necessary they are, we will describe the experimental installation established at the laboratory of the Compagnie Electrique by M. Hippolyte Fontaine with the help of Messrs. Nysten, Deheune and Chrétien.

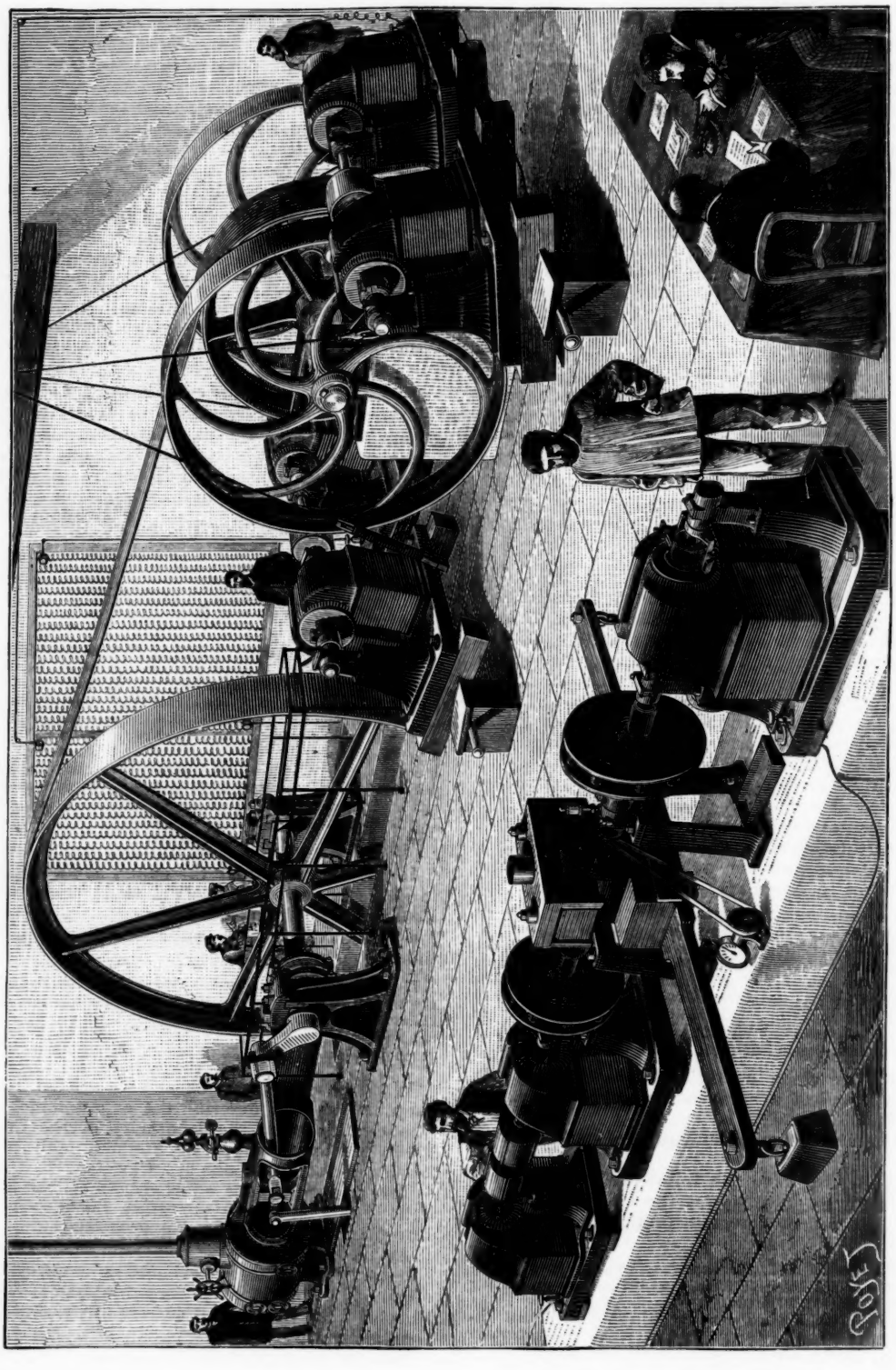
The transmission is effected by means of seven machines of a similar type, called the *type supérieur*, manufactured by the inventor, M. Gramme; four of these machines serve as generators and three as receivers. Each of them develops, at its normal angular speed of 1,400 revolutions per minute, an electromotive force of 1,600 volts and a current of 10 ampères. The four generating machines excited in series are connected in series with the three receivers themselves, also connected up in series with a line resistance of 100 ohms. The resistance of the armature is 4·75

* We may add to this list stoppages, frosts, droughts, and other contingencies which compel the majority of consumers to complete their hydraulic installation with a steam engine of a power at least equal to that of the fall utilised.

ohms, that of the field magnets 6·5 ohms, or about 179 ohms for the resistance of the circuit.

The four generating machines (in the background of the figure) receive the movement through the medium of two friction pulleys mounted on a shaft driven by the workshop machine. These machines oscillate on an axis placed beneath their bases, and springs stretched as required regulate the pressure against the actuating pulleys. This is an improvement upon the system employed at Sermaize in the experiments upon agricultural operations.

For receiving (see foreground of the illustration), the three Gramme machines are placed end to end, and connected together by couplings on the Raffard system; the mechanical power developed is measured by means of a Prony brake placed between the first and second machines. The total weight of the seven machines is 8,400 kilogrammes, and their total cost 16,500 francs.



DISPOSITION OF GRAMME MACHINES IN M. HIPPOLYTE FONTAINE'S EXPERIMENTS.

The fact ascertained by these experiments, the details of which may be found in the REVIEW for November 5th, 1886, is, that with seven Gramme

machines of an ordinary type, weighing altogether about 9 tons and costing 16,500 francs, it is possible to transmit an available mechanical power of 50 H.P. through a resistance of 100 ohms with an industrial rendering of over 50 per cent. But it is a great leap from this fact to the industrial utilisation of natural forces to a distance of 50 kilometres. It is not, in fact, sufficient to produce this motive power at a distance; it must also be distributed—if we may use the expression—in many distinct lots, working independently of each other and with a satisfactory result.

Up to the present the problem remains unsolved. We do not mean to say that it is insoluble—the rational employment of accumulators would remove many difficulties—but it is not solved yet, and none of the experiments made during the last few years have shown a solution than can be accepted, for we cannot admit as practical a system which consists in working by general transmission an electric generating machine which in its turn sends the current into other receivers, thus interposing four intermediate steps between the first motor and the utilising apparatus, and reducing the rendering to 15 or 20 per cent.

We must therefore make a distinction—and a very important distinction—between transmissions and distributions to a short or a moderate distance, which have passed into modern industrial practice, and transmissions to a long distance with high tensions, with the object of utilising natural forces, so erroneously considered free of cost. There is no need to enter into long calculations to show that, in most cases, the best transport from an economical point of view is the transport of coal; this is what, for many long years, will realise most simply and economically the transmission and distribution of motive force to great distances.

THE BERNSTEIN INCANDESCENCE ELECTRIC LAMP SYSTEM.

IN our last issue we gave a general description of the improvements recently effected by Mr. Bernstein in his system of electric lighting by low resistance incandescence lamps; the illustrations we now give show the actual arrangement of the switches, &c., adopted by the inventor.

Fig. 1 is a front elevation, and fig. 2 a plan of the switch, which may be briefly specified as a double-pole short-circuiting switch. All the working parts of the latter are fastened to the inside of a small ebonite cylinder closed at each end, so that contact from the outside with any part conveying a current is impossible. There are four segments fastened on the inside of this cylinder, two of which receive the line wires, and the two others the lamp wires. A central pin, which is insulated from all the working parts, carries an ebonite handle outside the box, and two metal pieces inside, which in a certain position of the handle connect the line wires with the lamp wires. If the handle makes one quarter turn, these two metal pieces rest on insulation; but before this can take place another piece of metal connects the two line wires, thereby producing a short circuit of the line inside the switch. Two metal bosses provided with a taper hole are connected with the segments which carry the lamp wires. The safety fuse or contact plug, which is shown by fig. 3, *f* being the oxide of mercury and carbon composition, fits into this hole, and if put in forms a shunt of high resistance to the lamp. The arrangement of the handle and the contact plug is made in such a manner that the current must be short-circuited before the contact can be removed, and it is further arranged that the contact must be put into its place in order to obtain a light in the lamp. This last has been done in order to prevent people from using a lamp without protection of the circuit by means of the contact.

In regard to the practical use of the system, as mentioned in our last issue, a small experimental plant has been in operation in the Alkali Works of Messrs. Brunner, Mond & Co., of Northwich, the light having been kept constantly running from 4 o'clock in the afternoon till 8 o'clock the next morning since the middle of October last year. Not the slightest hitch has occurred since the starting of the plant, and there has been no cessation of the lighting during the specified time even for one minute, although the plant is superintended by an engineer who never had anything to do with electric light before. This speaks well for

FIG. 1.

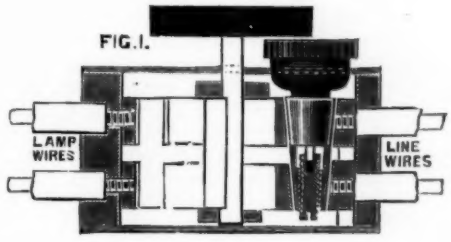


FIG 2.

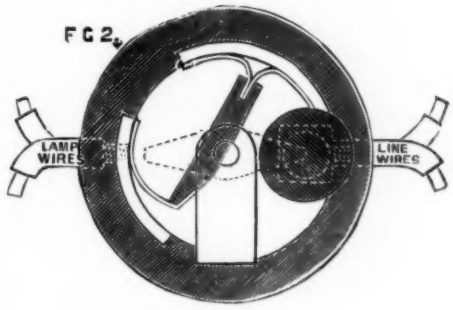
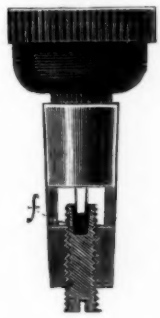


FIG. 3.



the security and simplicity of the system. Another plant was started in the Bernstein Company's factory about the same time, the light being kept running every day from morning to night. A third plant has lately been put in operation for lighting the cooperage at the above-mentioned Alkali Works and a fourth plant will be started immediately for lighting the saw mills of Messrs. Geo. Smith & Co., in the Commercial Road, S.W.

ELECTRIC TREMBLING BELLS.

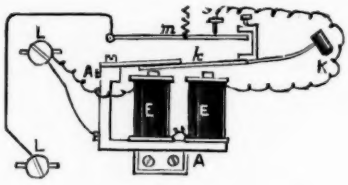
By M. WENNMAN, Chief Engineer, Swedish Telegraphs.

AGAINST trembling bells, as generally constructed on the "make and break" principle, several well grounded objections have occurred, of which the most important is that only one such bell can be inserted into the same circuit in order to secure regularity in the working of the bells. It is very well known that of several bells in series only one will work safely, viz., the one whose magnet is the most sensitive. The other bells will not

attain sufficient magnetism before the circuit is broken by the most sensitive, and they will consequently remain silent. Of course, if the bells are all of quite the same sensibility and of the same rate of vibration, and the conductor and intermediate bells afford no retarding effects on the current, more bells will answer even in series; but these conditions are practically impossible to fulfil. In parallel circuits make and break bells may be inserted, but such an arrangement is often inconvenient and impracticable; at least it is so as to telegraph or telephone stations inserted in series on the same wire.

Many proposals have come forth to obviate this inconvenience with trembling bells. One is to adjust all bells which are to be inserted in the same circuit to the same vibrating pitch; then to connect the armature of every bell with its back stop, except one, which is left unaltered. The bells whose armatures and back stops are thus connected, work as ordinary single stroke apparatus without interrupting the current; when placed in series with the unchanged one, they will follow the vibrations of the latter as far as the retarding effect of the conductor will allow and the waves of current are not thereby interrupted. An objection against this method is that the vibration of all bells is dependent solely on the vibration of one, or, in other words, that every bell is not its own vibrator.

Another well-known method of inserting more trembling bells in series is to make the connections in such a manner that the electro-magnet is short circuited by the contact between armature and front stop at every stroke of the hammer. But this short circuiting makes the magnet very sluggish and the vibration weak and irregular.



On some bell circuits in Sweden the bells are provided with a shunt, bifilary wound and of equal resistance as the bells, in order to always preserve continuity in the circuit. The end is, of course, attained, but only half the current will be useful, and the shunts render the magnets slow in working.

During the year 1885 the differential system was adapted to bridge over the break arising in the working of ordinary trembling bells. In this system, which is patented in Great Britain by P. Jolin, and in Germany by W. Averdieck, and well known to the readers of this journal, the electro-magnet is differentially wound with two spirals of equal magnetising power; only the one spiral is permanently inserted in the circuit. A current traversing this spiral will consequently attract the hammer lever; but at the moment when this lever touches its front stop the second spiral is connected in parallel circuit with the first one. The current now pervades both spirals in opposite directions around the magnet core, and the armature will consequently be withdrawn by the spring, thus effecting play of hammer. Although we have not in our country experimentally tested this system of trembling bells, we are apt to believe that the short circuiting of the first spiral by the second will create induction currents, which make the magnet sluggish and have a retarding influence upon the vibration of the hammer.

The problem presenting itself to the constructor of trembling bells is, consequently, to evade, on the one hand, a breaking of the circuit, and, on the other, a sensible short circuiting of the bell magnet. An attempt in this direction was made by me in the year 1883, and published in a printed form concerning the progress of telegraph technics during the same year. The connections in this trembling bell are easily understood by the accompanying figure.

The armature, *k*, of the bell is provided with an auxiliary lever, *m*, connected with the terminal screw, L¹. This lever, *m*, is, by means of a spring, pressed against a back stop, *v*, to which is affixed one end of the magnet spirals. The terminal, L, is connected both with the other end of the magnet spirals and with the armature, *k*.

The working is as follows:—The current enters at L, pervades the magnet spirals, back stop, *v*, and lever, *m*, to screw, L¹. When the armature, *k*, being attracted, touches the lever, *m*, the magnet is short circuited, and the current finds its way from L without resistance by *k* and *m* to L¹. But this short circuiting lasts only a moment, viz., as long as the armature, *k*, lever, *m*, and back stop, *v*, are all in contact. The next moment, by accumulated force of the hammer, K, the lever, *m*, is led away from *v* and the short circuit thus broken, without affecting the way of the main current. As the time during which the magnet is shunted is very short, the magneto current to be raised in the spirals by falling magnetism in the cores has scarcely begun to circulate before its way is interrupted, as shown. A close observation of the working of the bell shows that no sensible induction spark is generated in the breaking point between *m* and *v*.

The efficiency of this trembling bell is fully demonstrated by experience, there being many of them in daily use in connection with the telegraphs of the State. When more of them are inserted in the same circuit, the first armature attracted excludes the resistance of its magnet, thus reinforcing the current and facilitating the working of the next bell.

Relays and direct writers are not visibly influenced by the play of bells in the same circuit. Nevertheless a precaution is necessary, viz., that the trembling rates of the hammers are the same, or in multiple rate of that of the lever, *m*. Particularly if the vibrating rate of this lever should be slower than that of the hammer, short breaks can be caused in the circuit during the working of the bell. This inconvenience is easily eliminated by fastening a little poise either on the armature, between *k* and K, or on the lever, *m*, and adjusting, once for all, until armature and lever follow each other exactly.

This system of trembling bells is not patented by me, and—if not patented by another inventor—is consequently open to the free use of everybody.

THE ELECTRIC CHARGE ON THE ATOM.

ALTHOUGH considerable attention has been given of late to electrolysis, and the subjects connected therewith by English chemists, more especially since the Helmholtz Faraday lecture of 1881, yet, says A. P. Laurie, in *Nature*, some of Prof. Helmholtz's deductions from Faraday's experiments have been curiously neglected.

I refer more especially to the bearing of the facts on the true nature of valency, and I purpose in this paper to point out one or two fairly obvious consequences which follow from the results of Faraday's researches, but which have not, I believe, been stated before.

Prof. Helmholtz has shown that it follows from Faraday's experiments on electrolysis that while a monovalent atom carries to the electrode one charge of electricity a divalent atom carries two charges of electricity. For instance, when we electrolyse potassium chloride, we have each potassium atom delivering a charge of electricity at the one electrode, and each chlorine atom delivering an equal charge of electricity at the other electrode, all monovalent atoms, carrying with them an equal charge of electricity, which we may call the unit charge.

When, however, we electrolyse magnesium chloride, we have two atoms of chlorine set free for one of magnesium, and consequently while each chlorine atom

carries its unit charge with it, the magnesium atom carries two units of electricity to the electrode. In fact, electrolysis proves that differences of valency mean differences in the electrical charge on the atom. All this is so familiar to us now that I have perhaps repeated it at unnecesssry length.

But we have many elements which vary in valency. For instance, copper is capable of forming two series of compounds, in one of which it is monovalent, and in the other divalent, that is, in one of which the copper atom carries one unit charge of electricity, and in the other carries two units of electricity.

We are able, then, under certain conditions, to alter the electrical charge on an atom, increasing it by some simple multiple.

There are therefore a special group of chemical reactions, such as the oxidation of the cuprous salts, in which we have not merely combinations between two or more substances, or ordinary double decomposition, but in which, besides such changes, an additional electrical charge is given to, or removed from, an atom. I think it follows from this that all such reactions are of very special interest, and deserve careful study.

For instance, take the case of the saturation of an olefine by chlorine. We must look on this reaction from one of two points of view. Either on the addition of chlorine an additional charge is supplied to the carbon atom, in which case by-products of less saturation are probably formed; or the carbon atom is already fully charged, in which case the double bond is not merely a shorthand statement of a possible reaction, but expresses a physical fact.

There is also another point worthy of note in connection with this addition of electricity to the atom. If we take the case of the two copper chlorides—cuprous and cupric chloride—we find that their heat of formation per chlorine atom is not very different. Now, it is well known that the heat of formation of a salt approximates to the heat of formation, as calculated from the electromotive force developed when that salt is formed in a voltaic cell.

To put this in other words, we can obtain from the heat of formation of cuprous chloride, or of cupric chloride, an approximate calculation of the difference of electric potential between the copper atom and the chlorine atom in the two salts.

Now, as already stated, the heat of formation per chlorine atom is nearly the same; that is, the difference of potential between the copper and chlorine is nearly the same in both salts. What follows from this?

It follows that, in doubling the electric charge on the copper atom, the potential is not also doubled. This means, therefore, that the capacity for electricity of the atom is increased at the same time. This conclusion is not quite certain, as our information is still too scanty on the actual differences of potential in the case of these two salts; and, further, we do not know what fraction of it belongs to the chlorine atom; but, on the whole, the facts we have point to the above conclusion, and it is, at any rate, a subject well worthy of study to determine whether the capacity of the atom for electricity can vary or not.

Passing from this, I wish to point out another very obvious but nevertheless important deduction to be made from the facts of electrolysis.

We have recognised that the difference between monovalent and divalent copper consists in the doubling of the charge upon the atom. This again may be due to some profound change in the atom itself, but it is at any rate the obvious and marked distinction; we have copper in both cases, but double the electrical charge in one case over that in the other.

If we searched among the elements, could we find two series of salts more completely different in their nature and properties than the cuprous and cupric salts?

I venture to say that, if we did not know we could derive the same element from both, we should assume them to be derived from two different elements, and assign them very different places in Mendelejeff's table. Many other examples of the same thing will occur to everybody, namely, that alteration of the electrical charge on the atom is accompanied by profound alteration in the nature of its compounds, and is therefore probably the cause of this alteration.

Up to this point I think my deductions are fair and obvious deductions from the facts of electrolysis. I wish now to suggest a possibility, I can call it no more, which if true will considerably alter our views of the facts of chemistry. We have found the importance of alterations of electrical charge in altering the properties of an atom as shown in its compounds.

We already believe that variations in atomic weight are closely allied with the variations in the properties of the atom as shown in its compounds.

Are there, then, two things which condition the chemical properties of an atom, or is there only one?

Let us look again for an instant at the facts of electrolysis, and let us take the electrolysis of hydrochloric acid as our example.

At present we state the facts thus:—Every molecule of hydrochloric acid consists of one atom of chlorine and one atom of hydrogen, the chlorine atom weighing 35·5, the hydrogen atom weighing 1. On passing a current, each molecule is split into these two atoms, each atom carrying a unit charge of electricity.

Is it not just possible that we may some day state the facts thus:—A molecule of hydrochloric acid consists of one molecule of hydrogen weighing 1 combined with 35·5 molecules of chlorine each weighing 1. On electrolysis, the chlorine atoms are split from the hydrogen atom, the chlorine atoms each carrying unit charge of electricity, and the hydrogen atom carrying 35·5 charges of electricity.*

If this is the truth, then all the atoms of the elements are of the same weight, and probably are made of the same "stuff," and we have two, and only two, things which condition the properties of the atom—namely, its electrical charge and its electric potential, and Mendelejeff's table becomes a statement of the periodic relationship between these.

In suggesting this vague possibility, I do not wish to obscure the first part of the paper, which consists, I believe, of perfectly legitimate deductions from the facts of electrolysis.

I have purposely avoided giving many examples, as I have been dealing with such familiar and commonplace chemical reactions that plenty of examples will at once occur to every reader; and sufficient has, I think, been said to show at any rate the importance of experimental inquiry into this subject, and the probability of considerable modifications of our views of chemical facts in the near future.

The new way of looking on valency, which we owe to Prof. Helmholtz, may, as I have already pointed out, completely alter our conception of the nature of an unsaturated carbon compound, and of the process by which saturation takes place; and probably as investigation proceeds in this department, it will become necessary to re-dissolve our chemical facts and crystallise them out in completely new mental concepts, while doubtless the ideas associated with the graphic formula pass away and leave not a wrack behind.

ELECTRICAL PHENOMENA ON A MOUNTAIN.

"M. F." gives in a recent number of *Science* a brief account of some electric phenomena experienced by him last summer on Lone Mountain, a peak of the Gallatin range about 30 miles south-west of Bozeman, Montana. He says:—"In company with Mr. James Walsh, my assistant, I climbed this mountain on August 7th, 1886, for the purpose of making it a topographic station of my work in that vicinity. It is about 11,000 feet above sea-level, and higher than any other peak within a radius of at least 20 miles. It

* No one need quibble about the 35·5.

stands alone, being separated from the other high points of the range by low saddles. The mornings for two weeks previous had been bright and clear, but afternoon thunderstorms were of daily occurrence. The morning of August 7th was clear as usual; but about noon clouds had appeared in the west, and by 2 p.m. distant rumbles of thunder were heard, and dense black cloud-masses were sweeping towards us. About this time, as I was working at my plane-table, I heard a peculiar buzzing sound coming from the instrument, very much as if a large fly or wasp was imprisoned beneath one of the plane table sheets. Placing my hand on the table, I received quite a severe shock, and, starting back in surprise, felt another in my partly uplifted right arm. Immediately after the rocks about us began to hum and buzz in a peculiar manner, giving a sort of musical sound, and the hair of our heads, beards, and eyelashes to snap and crackle viciously. This phenomenon was felt with greater intensity in a small spot on the very tops of our heads, was accompanied by a tingling sensation, and at short intervals by slight shocks, which made us cringe involuntarily. On removing our hats, a tuft of hair stood upright over these spots. A shock was received whenever the hand came in contact with the head.

"Placing the instruments in a horizontal position under cover, we descended the mountain about 100 yards to a point perhaps 50 feet below the summit, and lay down flat. While in this situation, no unpleasant feelings were experienced, although the rocks still continued their musical hum; but the shocks and tingling sensations were immediately felt on raising any portion of our bodies to an upright position. The thunderstorm, accompanied by hail and rain, soon burst upon us, and continued for half an hour, after which the peculiar electric condition of the atmosphere passed away.

"We noticed during the storm that at least 80 per cent. of the lightning flashes passed between masses of clouds, and not between the clouds and earth, and that none of these flashes, as determined by the interval between sight and sound, were within a mile and a half of the peak we were on.

"The summit of Lone Mountain is a loose mass of broken volcanic rock. There are no large boulders or projecting points of any kind."

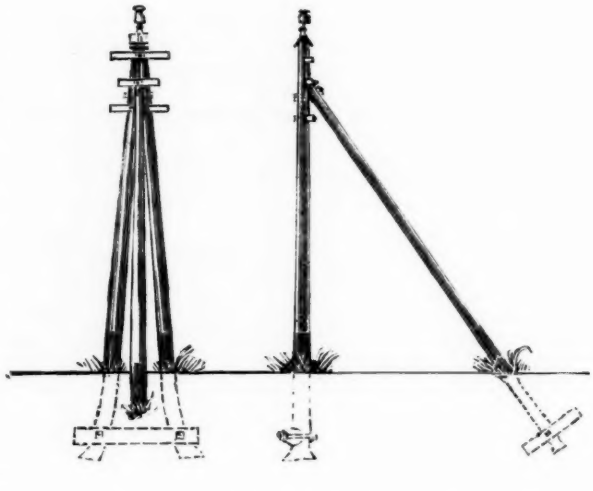
THE LIGHTING OF LIBRARIES.

PROFESSOR WIESNER has been examining the discolouration of paper and has, curiously enough, derived from his researches an argument in favour of gas as against the electric light, at least as far as libraries are concerned. He finds that light is a main agent in the yellowing of paper, especially such as is made of woody fibre. This action is due chiefly to the more refrangible rays of the solar spectrum, which are present in a much larger proportion in the sun's rays and the electric light than in gas light. Hence he draws the hazardous conclusion that "as regards the preservation of books gas light is preferable, for use in libraries, to the electric light." By a parity of reasoning, daylight ought to be excluded and libraries should be lighted up with gas at all hours of the day and the night. But it would seem that Prof. Wiesner has overlooked a consideration which turns the scale against gas. All coal-gas contains sulphur compounds which during combustion are converted into sulphurous and ultimately into sulphuric acid. These acids, as it has been repeatedly observed, exert both upon the paper and the bindings of books a destructive action far more important than the "yellowing" due to the more refrangible rays of light.

Before, therefore, we can consider gas a safer illuminant for libraries than the electric light, we must either obtain it absolutely free from sulphur—which is not practicable—or we must entirely convey away all the products of combustion, which is certainly possible, but not economical

GILBERT'S IMPROVED TELEGRAPH POLE.

THE illustrations show an arrangement of telegraph pole devised by Mr. A. Gilbert, Telegraph Superintendent of the Highland Railway Company. This arrangement has been adopted on an eight mile section of line between Dalnaspidal and Dalwhinnie. Mr. Gilbert objects to double staying and only employs a single pole and stay round sharp curves, all the other poles being of the A pattern.



The figs. represent a pole with a draw strut, the latter being only employed on every 8th or 10th pole to check the wires running back beyond that distance should they give way. It has been decided to adopt this mode of construction throughout the Highland line.

It should be mentioned that Mr. Gilbert has built lines on this principle for the Japanese Government in order to withstand typhoons and very severe snowstorms, and with considerable success. We do not know, however, whether the poles were heavily wired.

A NEW PRIMARY BATTERY.

THIS battery, the invention of Mr. Sidney F. Walker, is exactly similar to the Leclanché, except that in place of the oxide of manganese used as a depolariser, pure sulphur of the size of a pea or small bean is used, and that the proportion of sulphur required is smaller, both by weight and by volume than that of the oxide of manganese generally employed.

Its E.M.F. is a trifle below that of the porous cell Leclanché, while its resistance (according to the inventor) is very much less. The internal resistance and life of the cell can be varied within large limits by altering the proportions of sulphur and carbon employed. More sulphur gives a longer life for given work and higher resistance, more carbon gives lower resistance and shorter life. The ordinary life is about the same as that of a Leclanché.

The cell, it is stated, also possesses the valuable property of giving warning when it is worked out, or if subjected to an undue strain.

In the working of the battery sulphuretted hydrogen is formed, but does not come away unless the battery is worked very hard, or is nearly worked out, so that warning is given in the case of leakage, on house bell wires say, that will be very valuable. The amount of the gas given off is never sufficient to be noxious even under the conditions named.

The action of the cell, it is suggested, is as follows :—

Starting with Zn, N H_4 Cl, S C
First Zn, Zn Cl_2, 2 N H_3, H_2 S C
Next Zn, Zn S, 2 H Cl, 2 N H_3, C
„ Zn, Zn S, 2 N H_4 Cl, C

So that the whole of the work of the cell is done at the expense of the sulphur.

The statements of the inventor with reference to the battery are, we must confess, somewhat startling and certainly require verification. That the substitution of a non-conductor like sulphur in the place of the conducting oxide of manganese should lower the resistance of the battery is hardly credible, but that the electromotive force should be lower is quite possible; it is most probably that of zinc and carbon.

THE INVENTION OF SYNCHRONOUS ROTATIONS BY MEANS OF PAUL LA COUR'S PHONIC WHEEL AS USED IN TELEGRAPHY.

I HAVE lately had occasion to investigate some points in connection with multiplex telegraphy, and the latest methods of obtaining synchronous rotation of two wheels at the two ends of a telegraph wire. I have thus, and through original documents, been brought face to face with certain facts which may not be generally known, and which I therefore propose to discuss through the columns of this paper.

It is well known that the British Post Office has adopted within the last couple of years a multiplex system of telegraphy called "Delany's." This system was described in the ELECTRICAL REVIEW of February 2nd, 1884, in an article headed "Delany's Synchronous Multiplex Telegraph System," and was also made the subject of an interesting and able paper read before the British Association last year by Mr. W. H. Preece, F.R.S. It may also be of interest to quote some passages from a "Report of the committee on science and the arts of the Franklin Institute, on the Delany's system of synchronous multiplex telegraphy" (*Journal of the Franklin Institute*, April, 1886, No. 4, p. 312—318.) On p. 313 this report says :—"Mr. Delany's system is based on the phonic wheel of Paul La Cour, of Copenhagen." On p. 314 it goes on to say :—"Mr. Delany inserted in the circuit of the magnet of the vibrating fork a resistance coil, which could be automatically cut out when the vibrations were too rapid, thereby strengthening the current of the magnet and making the wheel revolve slower." What I here especially wish to draw attention to is :—

First. A perfectly reliable and sure automatic synchronism, based upon the phonic wheel (the invention of Mr. La Cour) existed long before Mr. Delany published anything.

Secondly. The very same, but improved synchronism, as described in the *Journal of the Franklin Institute* and in the ELECTRICAL REVIEW as mentioned above, was invented and patented by Mr. La Cour, prior to Mr. Delany bringing his invention before the public.

Now, as regards the *first* point, I have in my possession a document, signed by the Director of the Danish Government Telegraphs, stating that a synchronism, based upon the phonic wheel, maintained a perfect, satisfactory, and reliable multiplex working from June 17th to July 10th, 1880, between the two telegraph offices of Fredericia and Nyborg. This same document further says that the synchronism was easy to manage and gave no trouble, but the method being somewhat different from the one now in question, I shall not dwell longer on it here.

As to the *second* point, Delany (Calahan and Delany) took out his patent in the United States on the 17th of July, 1883, and in Great Britain on the 9th of October, 1883, and that these gentlemen had not previous to these dates published anything concerning this matter is shown by the reference, in the beginning of their specification, to Mr. La Cour's original patent for the phonic wheel, and not to any earlier work of their own. The phonic wheel, which is the base of the electrical synchronous movements of the particular class used here, was invented by Mr. Paul La Cour, of Copenhagen, and patented by him in Great Britain on the 17th of May, 1878. A full description of this invention and its several applications was given by La Cour in his pamphlet, "La Roue Phonique," Copenhagen, 1878, and a short article on the same is also to be found in the TELEGRAPHIC JOURNAL, of December the 1st, 1878. An important improvement as to regulating the velocity of rotation of the phonic wheel, and as to its general application for synchronising purposes was patented in Great Britain by P. La Cour on the 7th of October, 1882, or about nine months before Delany's American, and twelve months before his English patent. In August and September, 1883, at the Vienna Electrical Exhibition, Mr. La Cour exhibited his improved apparatus and demonstrated his inventions in connection with multiplex telegraphy. His system was also fully described at the time in several scientific journals and periodicals, for instance in the ELECTRICAL REVIEW of September the 22nd, 1883.

In September, 1882, La Cour sold his American patent for the *phonic wheel* to a Mr. Jones, of New York, and undertook to supply him with all particulars as to further improvements he (La Cour) might make thereon. Accordingly, La Cour in a letter dated the 1st of October, 1882, sent Mr. Jones a copy of his latest patent specification (the one taken out in Great Britain on the 7th of October, 1882), together with some particulars to help him (Jones) to carry out the practical working. Mr. Jones duly received this letter, and acknowledged the same, on the 8th of November, 1882; and on the 17th of July, 1883, Messrs. Delany and Calahan, who were working in conjunction with Mr. Jones, took out a patent in the United States for a synchronous multiplex telegraph system. They also patented the same (electric synchronous telegraphic and other systems) in Great Britain on October the 9th, 1883.

So much for the priority of the invention of this kind of synchronous rotations. It now only remains to investigate whether La Cour and Delany's systems of synchronisms are identical, or whether the possible deviations are of any theoretical or practical importance.

In La Cour's patent of October the 7th, 1882, it is shown that the synchronism may be maintained by changing the period or rate of oscillation of the vibrating body, either by altering the space between the poles of the electro-magnets and the branches of the tuning-fork, or by regulating automatically the strength of the current that acts upon the tuning fork. Automatic and perfect synchronous rotation is obtained by keeping a tuning fork at each end of a telegraph wire in constant vibration by a local battery. At one end the current of the local battery is connected through the tongue of a relay in such a manner that when the tongue touches one side the current is stronger, and the oscillations of the fork thereby become slower than at the other end. When the tongue, on the other hand, touches the opposite side, the current is weaker, and the oscillations of the fork consequently become faster. The adjustment itself is effected by sending an impulse (or a double impulse, positive or negative), for each rotation of the sending phonic wheel; this impulse throws the tongue of the relay to the one side or the other, according as the receiving phonic wheel is a little in advance or a little behind.

This in itself simple principle is, with various unessential embellishments, to be found throughout Delany's patent of October the 9th, 1883.

Delany uses six contact pieces for the regulating impulses instead of two, which number La Cour had found quite sufficient for a reliable synchronism (*vide* the Certificate from the Scientific Committee of the International Electrical Exhibition at Vienna, 1883, and *La Lumière Electrique*, 1886, No. 10, page 435-441).

He also sends regulating currents in both directions, which, again, La Cour found quite unnecessary; and he further employs special instruments (sounders) to prove that the synchronism is perfect. This addition La Cour also considers superfluous, as the synchronism is established three to four minutes after the instruments are placed in position, and not again interrupted unless serious disturbances should occur on the line. The only thing which by comparison, perhaps, at the first glance, might appear novel and better in Delany's modifications may be this, that Delany varies the strength of the current in the circuits of the electromagnets of the vibrating fork by automatic insertion of a larger or smaller *resistance*, while La Cour, in his specification of the 7th of October, 1882, allows the tongue of the relay, as described above, alternately to make connection with two batteries of different *electromotive force*. La Cour expresses this principle in general by speaking of a "stronger or weaker current," which result, of course, can be attained in different ways. Practically, the one has given as good result as the other; but the use of resistance coils was also tried by La Cour prior to Delany's English patent specification, for in August, 1883, at the Vienna Exhibition, La Cour experimented with it publicly, and finally adopted a combination of both.

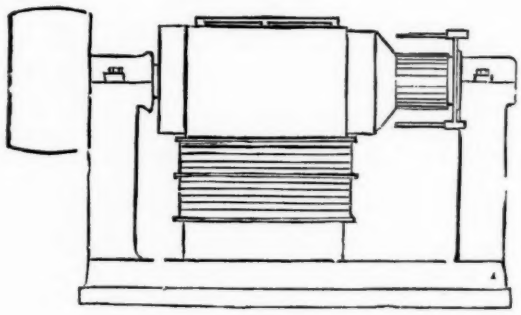
In conclusion, I may add that Mr. La Cour, not being in a position to support two patents in all countries (viz., that for the "phonic wheel," and that for "synchronous movements"), dropped the former after having disposed of the American one to Mr. Jones, whereas the latter is his property at the present moment.

P. CHR. DRESING, Mem. Soc. Tel. Eng.

THE ELECTRIC LIGHT AT "OLYMPIA."

THE permanent installation of electric light at this already popular place of amusement is now rapidly approaching completion, and is at present supplemented by a temporary installation of 60 arc lamps of the ordinary Brush type. Not only is this new installation of considerable magnitude, but it possesses features of peculiar interest on account of the area to be lighted and the difficulty of overcoming the effects of fog which, on account of the extent of the building, has no parallel anywhere so far as we are aware. "Olympia" at present consists of the great hall, which is 440 feet long and 250 feet wide, with a single span roof over 100 feet high in the centre. On the eastern end is a range of rooms consisting of general offices, board rooms, lecture room, dining rooms, and large refreshment and grill rooms; on the west end are two large ranges of buildings, now being used as the stables, fodder rooms, and harness rooms of the hippodrome. On the north-west side is another building of considerable importance, distinct from but communicating with the great hall. This is called the Minor Hall, having an assembly room, with large dining and supper rooms, retiring room and offices, &c., attached; this handsome building is 150 feet long and over 50 feet wide, and consists of three floors. Such is a brief sketch of the premises to be lighted by the installation we are about to describe. The generating electrical plant is underground between the two main buildings described, and consists of a dynamo room, 42 feet long by 30 feet wide, and a boiler room 32 feet long by 20 feet wide, communicating with the coal store, all under ground. The generating plant consists of four dynamos, each of 40 units; two compound steam engines, each of 200 H.P.; and three boilers, each of 200 H.P. As these boilers are of a type seldom used for electric light work, and have been designed and constructed with special care, some details may interest our readers. They are of the marine type and cylindrical, made of mild steel, manufactured by the Steel Company of Scotland by the Siemens-Martin process. The finished size of the shell of each boiler is 9 feet 6 inches diameter, and 8 feet 6 inches long, with two furnaces in each boiler. The furnace plate consists of a single plate, 10 feet 6 inches diameter, flanged to receive the double rivetted shells. The specified test actually applied to the plates of the boilers is a tensile strength of not less than 26 or more than 30 tons per square inch with a stretch of 20 per cent.; and, as a precaution against hardening in working, strips cut from the plates were required to stand the following test: to be heated to a cherry red and quenched in water at a temperature of 82° Fah., and afterwards to be capable of bending cold in a press to a curve, the inner radius of which is one-and-a-half times the thickness of the plate, without fracture. The stays for stiffening the end plates and tube plates to have an aggregate section of not less than one square inch for every 9,000 lbs., when the whole internal surface is pressed to 200 lbs. per square inch. The tubes are iron solid drawn of 3 inches external diameter.

The engines are of the compound horizontal type with a driving pulley 7 feet in diameter on each end of the crankshaft each pulley weighing 61½ cwt. with a surface speed of 2,200 feet. Each engine drives two dynamos direct by a double leather belt 12 inches wide without countershaft. The working speed of the engines is 100 revolutions per minute, and the steam pressure 100 lbs. per square inch. The engines and boilers are by Messrs. Davey, Paxman & Co., Colchester.



OUTLINE SKETCH OF A 40-UNIT SIEMENS DYNAMO.

The dynamos are compound direct current, each of 600 ampères, with an E.M.F. of 66 volts at the terminals, at a speed of 390 revolutions per minute, and were manufactured by Messrs. Siemens Bros. They are of a new type, remarkably compact and with a very high efficiency. This new type is to be known as Half H.B., which means half the field of the old form. In these particular machines the magnet coils are under the armature and the core and pole-piece solid wrought iron.

The work of wiring and fitting the whole of the lamps was done by the Anglo-American Brush Company, and comprises about 1,000 glow lamps of 17 C.P. actual at 60 volts, and 62 arc lamps of which four are to be used for lighting the approaches outside, and 58 for the Great Hall now fitted and used as the Hippodrome. The whole of the lamps, both arc and incandescent, work in single parallel. The arc lamps for the Great Hall are arranged in nine groups of six lamps, each of 12 ampères. They are at present fitted with ordinary globes, but are provided with a lantern 7 feet in diameter to take the whole group without globes, the lantern being in the shape of an inverted umbrella glazed with ground glass, and furnished with an opal shade or reflector of somewhat less diameter than the lantern. The groups are suspended from the main girders of the roof by cords of naked copper wire and counterbalanced so that the groups can readily be brought to the floor for trimming. Beside these groups there are to be four single lamps of 20 ampères each suspended in the same manner. The whole of

the nine groups are now in use daily and burn with remarkable steadiness. This important installation, which we have had the pleasure of inspecting, was designed, we are informed, by Mr. Farquharson, the consulting electrician to the company, Mr. A. H. Wood being the electrician in charge, and we must congratulate both these gentlemen on the result achieved.

REVIEW.

A Textbook on Steam and Steam Engines. By ANDREW JAMIESON, A.M.I.C.E., M.S.T.E London: Charles Griffin & Co., 1886.

Mr. Jamieson's book has been specially arranged for the use of Science and Art, City and Guilds of London Institute, and other engineering students, and comprises 30 lectures, which form the course of instruction given at the Glasgow College of Science and Arts. Since the appearance of Rankine's celebrated treatise a host of books on the steam engine has been written and it is therefore unlikely that in a new work we shall find any considerable addition to our general knowledge of the subject. The course of lectures before us partakes of the character of most lectures inasmuch as towards the end of the course we find important matter choked out which cannot possibly receive attention because the end of the session approaches. In the actual delivering of the lectures this may be inevitable, but no reason is thus afforded for allowing the fault to reappear when the course is published complete in book form.

In the first two lectures the author deals with the history of the steam engine from the day of Hero to the time of Hornblower, and describes clearly the improvements made by each inventor. In lectures III. to VI. are discussed the theory and phenomena of heat, their mutual conversion and their precise relation. Lectures VII. and VIII. deal with the properties of steam; the student being familiarised in lectures IX. and X. with the nature of the calculations necessary for determining the amount of condensation water required for jet and surface condensers. Mr. Jamieson is doubtless aware that in practice such calculations are but a preliminary step to the determination of the actual quantity allowed, the result obtained being multiplied by a coefficient "for contingencies and luck," which varies in value according to the experience of the designer. In lecture XI. we have an exposition of Boyle's Law; and in XII. are given the laws of the expansion of gases with a short account of the theory of heat engines and the doctrines of Carnot. In lecture XIII. the author explains the distribution of steam in the engine cylinder by the slide valve and gives Zeuner's diagrams by which the points of admission, cut-off, release and cushioning can be determined for any engine. We do not find it stated that the distribution of steam during the down stroke is quite different to what it is during the up stroke, an occurrence due to the obliquity of the connecting rod, which sometimes proves at first sight rather puzzling to students. In lecture XIV. is considered the expansion of steam with its isothermal saturation and adiabatic curves. The effects of liquefaction, steam-jacketing, super-heating and clearance are also considered, the lecture concluding with a paragraph on the theory of the compound engine. Lecture XV. explains the indicator and indicator diagram, while XVI. deals with the calculations for computating the horse-power of an engine. On page 137 we notice that in the formulæ for the horse-power the area of the piston is not subtracted from the cylinder area. Really A should be *the area of the cylinder — half the area of the piston rod* if the piston rod comes out at the crank end of the cylinder only. Of course in engine designing the cylinder is made considerably larger in area than would be given by the formula, since the indicator diagram differs considerably from the theoretical diagram; the correction coefficient before referred to, which depends upon the designer, is therefore brought into requisition. Lecture XVII. deals with the effects due to the inertia of the moving parts; and in this lecture is incorporated a valuable extract from Mr. Imray's paper on "High Speed Motors," read before the Institution of Civil Engineers last session.

The remaining thirteen lectures are devoted to describing the various types of land, marine, and locomotive engines. In describing engines of the first class, the author confines himself to three types manufactured by Messrs. Marshall of Gainsborough, namely, horizontal non-condensing, horizontal condensing, and compound semi-fixed. Mr. Jamieson describes these pretty fully, but we fail to find any mention of the Corliss valve gear, now so extensively employed in its various modifications for factory engines, nor is there any description of the various forms of hand-regulated expansion gear so frequently met with. Lecture XIX. gives the history of marine steam propulsion, and describes some of the early forms of paddle-boat engines. It must not be supposed from the "Grasshopper" engine being included in this lecture that it has gone out of fashion. As a matter of fact, we believe it has never been surpassed for towing purposes, and almost all the Thames tugs, new and old, are fitted with engines of this type. The modern "grasshopper" engine is an elaborate affair, however, having jet or surface condensing engines, variable hand-regulated expansion valve gear, disconnecting gear for uncoupling the engine-shaft so that one paddle can work ahead and the other astern, and foot-trip gear for enabling the eccentric gabs to be lifted off the valve levers and the engines instantaneously reversed by hand. This trip gear is very frequently employed in river steamers instead of the double eccentrics and link motion. Joy's valve gear, which is rapidly supplanting the link, especially in locomotives, is described at page 205, but we cannot find anywhere in the book indicator diagrams illustrative of the changes effected in the steam distribution by linking up the valves. As regards this portion of the book, dealing with marine engines, Mr. Jamieson's book is a decided advance upon previous ones having the same object in view. The engines and boilers illustrated are of the most modern and improved kind, and the student is not left, as is often the case, to fill in from imagination the details of a crude and badly drawn illustration. In lecture XXII. the author tells us how to mould a screw propeller. Might he not have stated that the cast iron of which it is made has melted with it, in order to toughen the blades, as much wrought iron as can be put in without obstructing the flow of the metal? The remainder of this lecture deals with the different forms of screw propeller. Why are no marine engine governors illustrated or described? We know of no mechanical appliance which has a more voluminous record in the Patent Office, and yet not one of the numberless forms is illustrated in this book, although not a few have had a fairly successful application.

The lectures on land and marine boilers, and on boiler construction, are very good, but the existence of the locomotive boiler is in these ignored, no reference being made to locomotives at all, save in the concluding lecture, where we have a hurried glance at their history and a well executed picture of an express engine. Doubtless in the next edition Mr. Jamieson will enlarge this portion of the book and give as much attention to the locomotive as to the marine engine.

With the general arrangement of the book we are well pleased. It is not a work which will teach the student practical designing, but for this it is not intended. Specifying first the ideal engine to be kept in view and the end to be aimed at, it goes on to describe clearly and happily the adjustments to that end which have been attained in modern practice. Well arranged and with a large quantity of information stored in small space we cordially recommend the work to all engineering students.

THE TELEPHONE BETWEEN PARIS AND BRUSSELS.

M. GRANET, Minister of Posts and Telegraphs, intends to start to-morrow (Saturday) for Brussels to hold a conference with his Belgian colleague, M. Vandenpeereboom, on the subject of the possibility of establishing communication between the subscribers to the telephonic systems of Paris and Brussels, thus rendering intercourse between the two capitals practical.

In our number for the 13th of December we published concerning the installation of this telephonic service certain information which we are now in a position to complete. We feel it our duty, besides, to remove certain doubts that have arisen on the subject of this experiment, the results of which, being now incontestable, are about to inaugurate a new era in European telephony.

Two great difficulties rendered telephony impracticable at a great distance; the first consists in the enormous expense entailed by the construction of special lines. The second arises from the fact that beyond a certain distance iron wires become, in consequence of their magnetic property, bad conductors of electricity.

The Van Rysselberghe system, applied successfully to a part of the French service, has obviated the first difficulty by enabling the telegraph wires to be used for telephonic communications, without in any way interfering with their good working.

This has been put into practice on the lines from Rouen to Havre, from Rouen to Elbeuf and Louviers, from Paris to Lille (250 kilometres), from Paris to Rheims, &c. It is known that on this last line the profits on the receipts, at the rate of 1 franc for five minutes' communication, are more than 50 per cent. Such a result, obtained in the first year of working and even before the subscribers in Paris are connected directly with those at Rheims, would seem to be the best proof of the good working of anti-inductive lines.

The experiment between Paris and Brussels will, in its turn, solve the second difficulty by showing that when a bronze wire is employed as an electrical conductor instead of an iron wire, remarkable telephonic communication is obtained over a length of more than 330 kilometres.

As there was no bronze wire circuit between the two capitals, the French and Belgian Governments have agreed to establish one on their respective posts. The first trials, which have just taken place, have given results that are perfectly conclusive, especially on the Belgian portion of the service, which is entirely anti-inductive.

Now, in order that the experiment may be complete and answer the purpose required, it remains to be shown that this bronze wire circuit can be employed simultaneously for telegraphy and telephony. This is on the point of being realised, and we may rest assured that it will be another success.

Lastly, official documents will be issued relating to the experiments made in various countries, to the effect that, given a special telephonic service, devoted exclusively to the telephone, the same circuit can without further cost be utilised for the telegraph, without any diminution whatever resulting either in intensity or in the purity of articulation. The setting-up of wires exclusively devoted to the telephone could not, therefore, be justified in any case, as there is no obstacle whatever to the simultaneous employment of the same conductors for the telegraph.—*Le Temps*, January 8th, 1887.

Electric Cars in Vienna.—Mr. A. Reckenzaun has recently visited Vienna, and has been in negotiation with the tramway company there for the introduction of his electric cars on some of its lines. Our valued contributor has had an attack of illness during his stay in the land of his birth, but we believe he is progressing towards recovery.

ON THE CONDUCTIVITY OF MIXTURES OF AQUEOUS ACID SOLUTIONS.*

By DR. SVANTE ARRHENIUS, of Stockholm.

1. *Methods employed and previous authors.*—Hitherto only comparatively few experiments on the conductivity of mixtures of electrolytes have been made by Bouchotte,† Paalzow,‡, Bender,§ and Klein,‖. These experiments have, moreover, led to no definite general results, mainly on account of the paucity of experimental data.

My experiments have been made at 25° C. in the chemical laboratory of the Polytechnic at Riga, on Kohlrausch's well-known method, with the use of the telephone.

2. *Distribution of the water among solutions.*—When two electrolytes are dissolved in the same water, two different views of the nature of the solution may be held: either *all* the water affects the one electrolyte as well as the other, or the water divides itself so that one part of it only affects the one electrolyte and only the remainder the other electrolyte. Experiments (by Ostwald) have been made with acetic acid and butyric acid. Normal solutions of these acids have conductivities respectively of 1·478 and 1·020. According to the second view the conductivity of the mixture will be $\frac{1}{2}$ (1·478 + 1·020). It was found to be 1·250 (instead of 1·249). According to the first view the mixture would have a conductivity equal to the sum of the conductivities of acetic acid of half normal strength (1·119), and of butyric acid of half the normal strength (0·853); this would give the conductivity of the mixture 1·972. Many such experiments were arranged, and all showed the superiority of the second view. All the experiment discussed in this paper also prove the soundness of this view. We shall consequently adopt this second view in what follows.

3. *Fundamental formula.* — If two electrolytes (in dilute aqueous solution) are mixed in the proportion $m : n$, and if the conductivity of the one solution be a, and that of the other b, then the conductivity of the mixture will be $\frac{m\,a + n\,b}{m + n}$ if the solutions suffer no change in the mixing. This formula is the mathematical expression of the idea that the conductivity depends solely upon the number of electrolytic (active) molecules per unit volume and on the friction of the ions in the solvent. This friction undergoes no appreciable change in dilute solutions.

4. *Consequences of the interchange of water in the mixture of solutions.*—When hydrochloric acid solution is diluted, the number of electrolytic molecules increases but very little,¶ (for the sake of simplicity we may assume that the number does not increase at all). When, however, a solution of acetic acid is diluted, the number of electrolytic molecules is considerably increased (*e.g.*, by dilution to twice the volume from a normal solution the increase is in the ratio of 1·51 : 1). When, therefore, solutions of hydrochloric acid and acetic acid are mixed, the conductivity will be greater than the above formula shows if water is transferred from the hydrochloric acid to the acetic acid solution, and *vice versâ*. In general when solutions of a stronger and a weaker acid are mixed, and the weaker acid takes water from the stronger, the conductivity will be greater than that given by the formula, and conversely if the stronger acid takes the water of solution from the weaker. A formula for this phenomenon is easily deduced; it shows that if the above consideration is valid the conductivities of the original solutions must not be very widely different; it likewise shows that the greatest deviations from the formula occur when the solutions are mixed in equal quantities.

5. *Isohydric solutions.*—If a given solution of an acid be mixed in equal volumes with solutions of another (stronger) acid of different degrees of concentration it is found that the above formula is applicable for a certain degree of concentration. For greater concentration negative deviations will be found, and on the other hand for less concentration positive deviations. According to the explanations given above, that solution of the second stronger acid, which possesses the particular degree of concentration, is of such a nature that it neither takes away water from the first solution nor gives any up to it when the two are mixed. On this ground I call in what follows two such solutions of different acids relatively *isohydric*. I have defined the concentrations of the solutions by their conductivities.

The experimental method for the determination of the conductivity of isohydric solutions will be most easily explained by means of an example.

To find the hydrochloric acid solution, which is isohydric with tartaric acid (75·51).** Under "observed" is placed the con-

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* An abstract of a paper to appear in Wiedemann's *Annalen*, specially made by the author, and communicated through Oliver Lodge. The translation made by W. N. Shaw.

† *C. R.* tome LXII., p. 955, 1864.

‡ Poggendorff's *Annalen*, Bd. CXXXVI., p. 489, 1869.

§ Wiedemann's *Annalen der Physik und Chemie*, Bd. XXII., p. 197, 1884.

‖ *Inaug. Diss.* Würsburg, 1885.

¶ *i.e.*, the molecular conductivity increases—I refer always here to dilute solutions.

** By this it is understood tartaric acid of conductivity 75·51. The units here employed may be reduced to Kohlrausch's by multiplication by 10^{-8}.

ductivity found, under "calculated," the conductivity calculated by the formula given.

	Obs.	Cal.	Diff.
5 cc. tartaric and solution (75·51) + 5 cc. hydrochloric solution (94·62)	84·49	85·07	− 0·58
cc. tartaric acid solution + 5 cc. hydrochloric acid solut'on (85·68)	81·54	80·0	+ ·78

By interpolation (and allowing for the error of observation = 0·5 p.c.), we get as isohydric with the tartaric acid solution (75·51) the hydrochloric acid solution (89·2 ± 2·9). In a similar manner the numerical values contained in what follows have been obtained.

6. *Examination of the view adopted in* § 2.—This examination was conducted in two different ways: (*a*) *Solutions which are found to be isohydric when mixed in equal volumes must also be isohydric when they are mixed in other proportions.*

This proved to be the case. Phosphoric acid (223·7) and hydrocholoric acid (167·4) were mixed in the ratios 3 : 1, 2 : 2, and 1 : 3; oxalic acid (4·947) and acetic acid (4·837) in the ratios 10 : 3, 1 : 1, and 3 : 10; tartaric acid (1·566) and hydrochloric acid (1·757) in the ratios 10 : 3, 1 : 1, and 3 : 10; acetic acid (12·18) and hydrochloric acid (14·54) in the ratios 10 : 1, 10 : 2, 10 : 4, 10 : 7, 1 : 1, 2 : 3, 1 : 2, 1 : 5, and 1 : 10. In no case was there a difference between the observed and calculated conductivities which reached the limit of the error of observation (0·5 p.c.).

(*b*) *Solutions which are isohydric with any the same solution must also be isohydric with each other.* Otherwise, as is easily seen, we might have three solutions, among which a permanent current of water would circulate always in the same direction. I have found—

A.—(α) Phosphoric acid (223·6) isohydric with oxalic acid (139·7 ± 7·5).
" " " " " hydrochloric acid (168·8 ± 10).
(β) Oxalic acid (141·7) " " " " (166·4).
B.—(α) Hydrochloric acid (88·59) " " tartaric acid (75·00 ± 2·5).
" " " " " oxalic acid (85·07 ± 3·5).
(β) Tartaric acid (75·39) " " " " (82·08 ± 3·3).
C.—(α) Formic acid (3·576) " " " " (4·301).
" " " " " hydrochloric acid (5·309).
(β) Oxalic acid (4·915 ± 0·17) " " " " (5·336 ± 0·13).

It will be seen that the numbers are perfectly satisfactory.

7. *Table of hysohydric solutions.*—In the following table particulars of isohydric solutions of six acids, as different as possible, are collected; their conductivities (multiplied by 10^8) are given, together with the possible errors. Above the conductivities I have put in brackets the number of gramme molecules per litre of the corresponding solutions. These are calculated from Ostwald's numbers. Solutions more concentrated than normal ones have not been investigated.

Hydrochloric acid.	Oxalic acid.	Phosphoric acid.	Tartaric acid.	Formic acid.	Acetic acid.
(0·1737)	(0·513)	...	...	...	...
609 ± 35	607	...	...	...	...
(0·0461)	(0·0625)	(0·337)	...	...	...
168·8 ± 10·0	139·7 ± 7·5	225·6	...	...	...
(0·0238)	(0·0031)	(0·0764)	(0·520)	...	...
88·6 ± 2·9	85·1 ± 3·5	82·2 ± 8·2	75·0	...	...
(0·00475)	(0·00488)	(0·00702)	(0·0260)	(0·1077)	(1·000)
17·98 ± 0·46	16·27 ± 0·46	16·11 ± 0·72	16·41 ± 0·45	16·85 ± 0·64	13·81
(0·001402)	(0·00135)	(0·00163)	(0·00324)	(0·01261)	(0·0965)
5·336 ± 0·134	4·915 ± 0·175	4·926 ± 0·174	4·903 ± 0·146	5·467 (± 0·15)	4·855
(0·000349)	(0·000396)	(0·000440)	(0·000498)	...	(0·009175)
1·524 ± 0·032	1·582 (± 0·05)	1·479 ± 0·057	1·499 ± 0·20	...	1·476

8. Since obviously any solution of two acids in the same water can always be represented as two isohydric solutions, it follows that *when two acid solutions are mixed the two acids divide themselves with reference to the water, so that two isohydric solutions are formed.*

From the above table it follows that the specific conductivities of isohydric solutions are approximately equal.

Further considerations, which cannot here be given, show that if the conductivity of a mixture of acids is calculated on the assumption that solutions of equal conductivity are isohydric, the probable error amounts to 1 per cent., being rather greater if the strengths of the acids are very different, and less if they are nearly equal.

9. *Supplementary Remarks.*—The different bases have also been examined in a perfectly similar manner. The results obtained are strictly analogous, including the equality of the conductivities of isohydric solutions. However, the carbonic acid of the air had produced a disturbing effect to such an extent that the numbers are too uncertain for publication. I have also found that acetic acid (1·166) is isohydric with ammonium acetate (0·469). The ratio of the conductivities of the two (2·485 : 1) is nearly the same as the ratio of the maximum values of the conductivities of acids and salts (2·83 : 1 according to Kohlrausch). This seems to point to the conclusion that an electrolytic or active molecule of an acid (at ordinary temperature) in water conducts 2·83 times as well as an electrolytic molecule of a salt, and not that in extreme dilution the acids are, say, more loosely combined ("disagregirt") than the salts. This arises probably from a smaller friction of the ion H of the acid (probably also of the O H of the bases) with respect to the water, in which it also occurs as an ion, than occurs with the other ions. This difference might disappear at higher temperatures.

From the hypothesis that the different electrolytes divide the water between them there arise relations which promise to explain some very curious phenomena. If, for example, a weak acid or base and a neutral salt are dissolved in water isohydric solutions will be found, in which the weak acid or base will get extremely little water. In consequence, its molecular conductivity, and accordingly the number of active molecules, will be very considerably diminished. I anticipated this on other grounds in my paper of 1884,* and endeavoured in that way to explain that the weak acids prove to be much weaker on mixing with bases than they are for the same concentration when no other bodies are in the same solution. The same hypothesis may also explain the great depreciation of strength of weak acids when neutral salts are present, as calculated from the rapidity of reactions,† and of the weaker bases in saponification reactions. I am still engaged upon the solution of similar questions.

PROPOSED ELECTRIC LIGHTING OF THE BRIGHTON PAVILION.

THE Corporation of the "Queen of watering places" have been sorely perplexed in their minds of late as to the best mode of lighting their fine Pavilion, and the matter was discussed at length, but not determined upon, at a meeting last week. A long report was presented by the Committee, which recommended that the use of the electric light in the Pavilion and dome, the picture gallery, library and museum should be resumed; that secondary batteries should be employed, sufficient for ten hours' lighting of the banqueting room, corridor, saloon and one drawing room (to accomplish which 106 cells would be required at a total estimated cost of £660); that the wires should be relaid in grooved boarding as recommended by Mr. Preece; that the services of an electrician should be obtained at a salary of £2 a week; and that there should be no renewal of the arrangement with Mr. Volk, it being considered that the use of secondary batteries with an electrician to attend to them, would sufficiently provide against the contingency of a failure of light. The expenses of carrying out the proposed alterations were as follows:—Alterations recommended by Mr. Preece, £412 15s.; secondary batteries, £660—Total £1,072 15s. This expenditure, it was explained, might be met either by a special rate or by the borrowing of the money under the Brighton Pavilion Act of 1867.

Alderman Hallett, in moving the adoption of the report, advanced numerous arguments in favour of resuming the use of the electric light, and pointed out that secondary batteries were now made use of in all the best and most perfect installations, as they were found to secure steadiness of light while acting as "governors" on the engines working the dynamos, and preventing any waste. A 40 horse-power engine running at a moderate speed would supply energy for 600 lamps such as they were using, and if they only used 400, superfluous energy could be stored for a future use. Hitherto if only 100 lamps were required they had been obliged to run the engine, but with accumulators this state of things would be entirely obviated and less strain would be imposed upon the working staff. Proceeding to combat the suggestion that the surplus occasioned by the greater expense of electricity as compared with gas would be wasted, the alderman pointed out that if they decided to employ the latter illuminant once more the pipes and fittings would, for safety's sake, have to be so extensively overhauled and repaired that a considerable expenditure must, of necessity, be involved.

Councillor Dell seconded the motion, and in the course of the animated discussion which ensued, Alderman Lamb pointed to the daily increasing use of the electric light in the Metropolis as well as in all parts of the country. Perhaps they had not had in the past quite so careful a man to look after the electrical apparatus as might have been desired, and hence the occasional flickering which had been noticed. But imperfections of that kind would be entirely obviated under the new system.

A little "scene" was occasioned by the accusation hurled by Councillor Berry at Alderman Lamb, to the effect that the latter had started the electric light and put in one of his own *employés* to superintend it. Alderman Lamb denied this, and the Mayor requested a withdrawal; the request was not complied with and was not pressed.

Ultimately a motion was submitted by Alderman Bennett, shelving the question for six months, which was lost, and the matter was then adjourned till the next meeting.

* "La Conductibilité Galvanique des Electrolytes," Partie II., p. 77.

† Spohr, *Journ. f. prakt. Chem.* [2], XXXII., p. 32.

FATAL ELECTRIC LIGHTING ACCIDENT.

ON Friday evening last week Mr. St. Clare Bedford opened an inquiry at the Board Room, Poland Street, concerning the death of Richard Grove, aged 17 years, lately residing at 52, Ling Buildings, Long Acre. Mr. Mortimer Davis, a tobacconist, carrying on business at 84, Regent Street, deposed that the deceased was his errand boy. On the 3rd inst. witness was returning home to dinner at half-past six, and on passing the premises of Messrs. Gerrard and Co., florists, which adjoin his own, he noticed that the electric light was out, and someone was lighting the gas. His own shop was not lighted by electricity. He went into the florists' and said, "Hallo! what's the matter?" and the assistant replied, "Our electric light is out of order; I dare say you will notice a strong smell of burning in your house." Witness went indoors and was met by an overpowering smell of burning varnish and wood. Almost immediately afterwards he saw a tremendous flame shoot out of the closet window next door. He then ran into Messrs. Gerrard's and heard several loud explosions, and flames flew out to a distance of about 10 feet. As there was nobody present who knew how to cut off the electric current, witness went to the Vine Street police-station, where an inspector advised him to send to the Grosvenor Gallery, whence the supply came. Witness despatched a messenger thither, but, in the interim, fearing the premises would catch fire, he gave the deceased a pair of shears and told him to get out of the first-floor window and cut the electric wire. He said he could do it better on the roof, and before witness could speak he had got to the top of the house. The flame and explosion suddenly ceasing, witness concluded that the current had been turned off at the Gallery. A moment later he heard a crash, and eventually discovered that the deceased had fallen through a skylight from a height of 60 feet. He was found in the cellar quite dead. Dr. J. R. Kemp, of 101, Regent Street, who made a post-mortem examination, said the cause of death was a fracture of the skull and concussion of the brain. He was quite satisfied that the unfortunate lad was not killed by the electric current. Police-constable Addington, 372 C, stated that he examined the roof of the house, and found that the deceased had severed the gutta-percha covering of the wire, which was visible. Mr. G. L. Addenbrooke, of 9, Mecklenburgh Street, engineer in the service of Sir Coutts Lindsay & Co., said in cutting through the gutta-percha covering of the wire the deceased might or might not have received a shock of a slight character. The flame which Mr. Davis and the police-constable had described would be an electric spark four inches long, and blinding in its nature. Anyone looking at it would think it was a flame. The shears the deceased was using would act as a conductor, but as the current would be only the "leakage to earth," the shock would be very small indeed, and not sufficient to destroy life. The explosions which had been spoken of would be caused, he thought, by the spark igniting water which had been decomposed by the current. The inquiry was adjourned for a few days to give the jury an opportunity of inspecting the premises and apparatus.

The adjourned enquiry was resumed on Wednesday, when Lieut.-Colonel Armstrong, R.E., watched the case on behalf of the Board of Trade. Sir Coutts Lindsay & Co. were represented by Mr. A. Curtis Hayward, solicitor. After an argument between the coroner and the foreman of the jury as to whether the latter should make a statement respecting the jury's view of the premises, and as to the propriety of his (the foreman's) writing to the Board of Trade requesting that a representative of the Board should attend the enquiry,

John Rahder, employed at Messrs. Gerrard's, florists, stated that on the Monday evening he saw a bright light near the battery, which was placed in the water closet. He went to turn off the current, and whilst doing so the bright light again became visible. Witness sent to acquaint a policeman and also the electric lighting company, as he was afraid the house might catch fire. After he had sent, Mr. Davis came into the shop and asked what was the matter with the light, at the same time requesting witness to cut the wire. Witness was about to do so when a young lady called to him not to, as it would be dangerous; he therefore declined. Mr. Davis then went back to his own shop, and a few minutes afterwards witness heard a tremendous noise. Going downstairs he saw deceased lying in a box.

By the Coroner: The light which he saw appeared to him like flames.

By Mr. Hayward: These flames were burning at intervals for a quarter of an hour. The young lady told him not to cut the wires, because of the danger, in Mr. Davis's presence.

Mr. Davis questioned the witness upon the last statement, but elicited the same reply, which he (Mr. Davis) said was quite wrong.

Miss Marion Law, assistant at Messrs. Gerrard's, said she was with the previous witness on Monday evening at half-past six, at which hour he left her and went downstairs. Just afterwards she heard a noise downstairs, but went on with her work. The noise increased, and sounded like an explosion or the reports of cannon. She also thought it was like the noise of something falling. After more than five minutes she went downstairs, when she saw the water-closet full of flames. She went into the shop and reproached the other assistants for leaving her upstairs to be burnt; she advised the others to get their clothes and go, as she thought the place would be burnt. She went to the upper room for her things and returned to the shop. The explosions were still going on. She asked if anyone had gone to the Grosvenor Gallery and was told that someone had. A policeman came in and suggested that someone should go in a cab to the Grosvenor Gallery. A cab was accordingly called and she went in it to the Grosvenor Gallery, where she was told that someone had already been from 84, Regent Street, and they thought a man had gone to put the fire out. She said thinking was no good and they had better send someone back with her. Enquiries were made, and she was informed that a fireman had gone. She thought one man would not be enough, but they told her it would be all right. Returning to Regent Street, she saw that the light was out, and supposed that the man had come from the company. She was informed, however, that nobody had called, but that Mr. Davis's boy had fallen from the roof. She was away about ten minutes or a quarter of an hour.

By the Coroner: The electric light had been used ever since the shop was opened about twelvemonths ago. It had occasionally gone out, and they had had two small fires in the battery, but they were not so serious as that on the last occasion. They moved the boy into the cellar and put a pillow under his head, and after that the man from the Grosvenor Gallery came.

By the Jury: The light she saw was like fire, and she thought the house would be burnt down.

After another argument between the Coroner and the foreman of the jury, Lieut.-Colonel Armstrong was called, and stated, in reply to the question whether any danger was likely to accrue from the attempt to sever the wire by means of a scissors, that it would depend upon the electrical insulation of the rest of the circuit. If the insulation were bad, the boy would receive a shock sufficient to kill him; if the insulation were good, he would not have been hurt. It could not be ascertained now, so far as he knew, what was the condition of the insulation at the moment the boy touched the wire, for it was on no two days alike. The Coroner: If it is possible to kill with a direct current or shock, would any external mark be shown?—Lieut.-Colonel Armstrong: I have no personal experience. I have seen cases of men who have had heavy shocks and have not been killed, and they have been marked. In reply to the jury, who asked if he would have objected to cut the wire himself, witness said he would not have dreamt of doing

such a thing. If he was quite sure that the insulation was perfect at all parts of the circuit, he should have had no hesitation; but if asked hap-hazard to sever the wire he should certainly have refused. Mr. Hayward said he wished it to be quite clear to the jury that touching the circuit at one point with a scissors would not necessarily cause a shock. After a retirement of nearly half-an-hour's duration, the jury handed in the following verdict and rider:—"That the deceased, Richard Grove, was killed by falling from the roof of 84, Regent Street, whence he had gone for the purpose of cutting an electric wire, but whether he received an electric shock or missed his footing there is not sufficient evidence to show; but we desire to express our opinion that all electric wires and batteries within reach of any person should be protected so as to render such accidents impossible. We also consider that electric light companies should leave printed rules with their customers not to touch or interfere with wires or batteries, but to at once inform the company of any defects."

[This matter is referred to in our leading article, which, however, was written before the holding of the adjourned enquiry reported above.—EDS. ELEC. REV.]

THE LATE SIR FRANCIS BOLTON.

IT is our painful duty to record the death of Sir Francis Bolton, which occurred late on Wednesday night last week at the Royal Bath Hotel, Bournemouth, where Sir Francis and Lady Bolton had been staying for the last two months.

Colonel Sir Francis John Bolton, who was a son of Dr. T. W. Bolton, was born in 1831. He entered the Army at the age of 26, and, after three years' active service on the Gold Coast, for which he received special thanks, was promoted to a captaincy in the 12th Foot. Subsequently he served on the Staff as Deputy-Assistant Quartermaster-General, and was attached to the Royal Engineers at Chatham. In 1868, in consideration of special military scientific service, he was given an unattached majority. He retired in 1881 with the rank of Colonel. Sir Francis was the inventor of the system of telegraphic and visual signalling which was introduced into the Army and Navy in 1863. For these services and other improvements and inventions in regard to warlike material the Queen, in 1883, conferred upon him the honour of knighthood. Since 1871 he had been the water examiner under the Board of Trade. In connection with the late Robert Sabine and Major-Gen. Webber he founded, in 1870, the Society of Telegraph Engineers and Electricians, of which he was Vice-President and Hon. Secretary. Sir Francis Bolton will be best recollected by the general public in connection with the Health, Inventions, and Colonial and Indian Exhibitions, in all of which he played an important part. It was entirely due to the invention of Sir Francis that the prismatic fountains, which formed such an attraction at these exhibitions, were introduced, and it was under his immediate supervision that they were installed and improved. The Colonel was an implicit believer in his invention, and continued improving and enlarging on it up to the time of his death. The manipulation of the electric signals by means of which the fountains were worked was rarely entrusted to anyone by the inventor, and six nights out of seven it was Sir Francis himself who directed the operations from the little room in the clock tower. It was his great delight to be surrounded by ladies and gentlemen of his acquaintance, to whom he loved to exhibit the working of the machinery, and he was generally accompanied by a small circle of friends on his visits to the tower. Sir Francis had for a long time past been an acute sufferer, the symptoms of his disease which gave most trouble being an almost total loss of voice. In the hope of improving his condition, he underwent several operations, but with little result, and experienced considerable pain, notwithstanding which he invariably appeared in the best of spirits, and frequently made jokes at his own expense in reference to his loss of voice. Sir Francis was in appearance of somewhat burly build, and had a fine presence. He was exceedingly popular with all who came in contact with him, and his bearing towards his employés, even of the lower grades, was such as to render him exceedingly popular with them also. Sir Francis married in 1866, a daughter of Mr. R. Matthews, of Oatland's Park, Surrey.

The interment took place on Tuesday, the 11th inst., at the Cemetery, Hastings, that being the last resting place also of the deceased's mother. Amongst those present were Mr. M. W. Bolton, brother of deceased, his cousin, Colonel Braham, his partner, Mr. P. A. Scratchley, M.A., his solicitor, Mr. G. A. Gadsden, and Mr. Thomas Bond, the eminent surgeon. The Society of Telegraph Engineers and Electricians was represented by Major-General Webber, C.B., late R.E., one of its past presidents; Mr. W. H. Preece, F.R.S., also a past president, who was associated with Sir Francis in connection with the electric lighting at the recent exhibitions at South Kensington, and Mr. F. H. Webb, the secretary. There were also present:—Mr. J. H. Francis, engineer to the New River Company; Mr. M. W. Morris, engineer to the Trent Water Company; Mr. W. E. B. Farnham, Mr. F. E. Lewis, Mr. J. D. A. Norris, Dr. Winter Fisher, Mr. H. Bird, and Mr. H. Richards. The following gentlemen represented Sir Francis' staff, Mr. D. Urquhart, Mr. W. Bates, and Mr. R. Loam. Several members of the Council of the Society of Telegraph Engineers would have been present had not important engagements rendered it impossible. Mr. James Sivewright, C.M.G., one of the oldest members of the Society, came up from Scotland on Monday night for the purpose of attending the funeral, but was prevented by the late arrival of the train from reaching Victoria Station in time to proceed to Hastings.

NOTES.

Temporary Lighting.—The principal thoroughfares of the town of Batley were brilliantly illuminated on Christmas eve and on the preceding evening by Messrs. Goolden and Trotter, of Halifax. Eleven arcs were run on a circuit of rather more than one mile in length. The lighting was carried out under the direction of the Tradesmen's Association, and we believe it had the desired effect of assisting a brisk Christmas business.

Electric Lighting at Penzance.—Considerable satisfaction is felt at Penzance on account of the unqualified success which, it is admitted on all hands, attended the recent experiments in electric lighting undertaken by the enterprising firm of Messrs. Laing, Wharton and Down, on the Thomson-Houston system. No decision has yet been arrived at by the corporation as to the desirability of adopting the electric light for public lighting purposes, but Messrs. Laing, Wharton and Down are prepared, if a certain number of tradesmen will agree to adopt the proffered improvement, to start a company in order to supply their needs. Messrs. Laing, Wharton and Down will now commence experimental operations in the "Three Towns," where the enterprising spirit of the inhabitants ought to ensure a commercial triumph.

Electric Light in Sussex.—In honour of Mr. W. W. Grantham, eldest son of the judge of that name, attaining his majority, festivities were inaugurated last week on an extensive scale at Barcombe Place. A special ball-room was erected for the occasion, and to add brilliancy to the many decorations a number of incandescent electric lights were made use of, with the result that the atmosphere was kept comparatively cool.

Proposal to Light Halifax by Electricity.—At the monthly meeting of the Halifax Town Council held last week a communication from the Maxim-Weston Electric Company, Limited, was read relative to lighting the town of Halifax with the electric light. The company offers to supply 1,000 lamps, 20 candles each, including all necessaries, for the sum of £3,000, provided the council saw their way to purchase the plant out-and-out, or to maintain the system at an annual cost of £700. The letter was referred to a special committee.

The Electric Light at Leeds.—In the annual report of the Electric Lighting Committee of the Leeds Corporation, information is given as to the experiments made with the new illuminant in the Free Library and Victoria Hall, and a comparison is made as to the cost of lighting by gas and by electricity during a period of 452 hours. This comparison shows that "whilst—including the capital account—the system of electric lighting by incandescent lamps is 100 per cent. dearer than the system by gas; yet, taking the actual quantity of light produced, viz., 2,669 candles of gas against 5,620 candles of electricity, electric lighting costing even so much is, in fact, cheaper than gas lighting, besides avoiding the alleged objectionable feature of the latter." The committee further states that "out of the £10,000 granted by the council in May, 1883, for the electric light, the sum of £4,932 7s. has been expended. Of this amount the sum of £522 9s. 4d. was on revenue account."

Tunnel Lighting.—The arch of the Huy tunnel, in France, was recently discovered to be giving way at a distance of 700 yards from the entrance, and, to facilitate the work, *Industries* states, the electric light, arc and incandescent, has been employed with great success. The dynamos and small steam engines were placed at the entrance to the tunnel, steam being supplied by a locomotive. The whole installation was put up in a few hours, and work proceeded night and day.

Electric Lighting in the Suez Canal.—We last week announced that it was expected that the Suez Canal would be open for night traffic in about a month. The *Engineer* now states that MM. Lesseps and Stokes have been making experimental trips by night to various portions of the Suez Canal with the electric light; and that in a few days the whole of the canal will be opened for night traffic by the aid of the electric light, thus shortening the passage through by twenty-four hours.

Electric Lighting in Spain.—The municipality of Lorca is inviting tenders for electric lighting, and, *Industries* says, the conditions are favourable to contractors. A monopoly for fifty years is offered, both for public and private lighting, and the town engages to take 260 20-C.P. lamps, paying £720 per annum. The price for private lighting is left open.

Bayreuth and Electric Lighting.—The authorities of Bayreuth have decided not to introduce the electric light, although gas is very dear in Bayreuth.

Electric Light for Glasgow.—At a meeting of the Glasgow Bazaar Committee, held on the 27th ult., the chairman, on behalf of the sub-committee on electric lighting, reported that they find that engines and boilers capable of supplying the necessary power for lighting the new bazaar, City Hall, and the new Municipal Buildings by electricity, with the necessary fittings for the bazaar and City Hall, could be provided for about £3,000, the necessary accommodation for the engines and boilers being provided under the new bazaar adjoining the new police buildings. The committee resolved to recommend to the Town Council that the proposal should be carried out.

Electric Light v. Gas.—It is said that "the authorities seriously contemplate lighting Hampton Court Palace with gas." "One does not expect," says the *Evening Standard*, "that these deliberate gentlemen, or ladies, will adopt a novelty until it has grown into an antique. They are about to charge the nation with the cost of laying gas at the moment when gas, for illumination, is superseded. They are abandoning oil upon the ground of danger, and taking a substitute ten times more perilous, whilst there is one so tried and so sure that the British Museum has adopted it. As for taking up gas at the moment when wise men are dropping it, officials may plead the example of Croydon. That town, not fossil, not perhaps beyond the average of dullness, nor peculiarly liable to be victimised by specious jobbers, is actually begging the privilege to raise half a million sterling for the shareholders of its gas company, when the triumph of the electric light is as certain as to-morrow's sunshine." We suppose the confident tone of our contemporary as to the certainty of the electric light ultimately replacing gas is based on practical experience of its use in its own offices, where, we understand, there are over 500 incandescent lamps and 6 Fyfe-Main arcs installed by the Fyfe-Main Electric Lighting and Construction Company.

The Electric Light for "Divers" Purposes.—The steamer *Hyena*, belonging to the Liverpool Salvage Company, has been fitted with electrical apparatus for diving purposes.

Telephone Wires in Germany.—The German Post Office, according to *Industries*, is now using to a considerable extent the new anti-induction telephone cables made by Messrs. Felten and Guilleaume, and others. The usual cable for overhead circuits contains wires of 27 to 30 mils. diameter, each separately insulated, and wrapped on the outside with tinfoil. The cable thus formed is surrounded with three naked copper wires, and sheathed with a lead covering. The whole is protected by a hemp taping and bitumen. These cables when used for overhead circuits are not strong enough to support themselves, and must be suspended from cast steel wires. The three naked copper wires, as well as the wrappings of tinfoil, are all connected to earth. A smaller cable, containing only fourteen wires, is also manufactured. A large number of these cables are now erected throughout Berlin, and are used with satisfactory results.

The Telephone in Vienna.—The Telephone Company in Vienna is increasing its capital from 500,000 to 600,000 florins, and is now engaged in increasing the number of its wires. In most cases, says *Industries*, the additional cables will be laid underground. The total number of subscribers to the exchange has not yet reached a thousand.

The Storm and the Telephone.—A circular has been issued by the United Telephone Company to its subscribers, in which the directors of the company "regret to inform their subscribers that the Metropolitan telephone system, in common with telegraphic communication throughout the country, has been *interfered with* by the late severe storms." It is highly creditable to the morals of the directors, says the *Financial News*, that in such exasperating circumstances they should have been able to restrict themselves to the mildest kind of Parliamentary language. After taking note of the fact that the system "has been interfered with," they proceed to mention a few other incidents which may be interesting to their subscribers. "Suitable labour is somewhat scarce and difficult to procure." Presumably it does not come to elderly gentlemen who sit in easy chairs at the fireside and wait for it. "The weather also is unfavourable, and the working days are short." The weather of this unhappy country often is unfavourable for outdoor occupations, but we have all to do a bit of outdoor work occasionally, nevertheless. The United Telephone workmen must

take the bad climate and the short days like the rest of us. The Post-office linemen were not by any means too smart with their repairs, but they needed only a few days, while the staff of the United Telephone Company expects apparently to have weeks or months. The directors and managers of the United Telephone Company have never yet got credit for doing "all that is possible" in any branch of their business. From the first they have not shown the energy and spirit which their undertaking required. In their hands it has not grown as it ought to have done. Its provincial offshoots have been far more enterprising, and have made much more rapid progress than the parent company. This fact is becoming so patent that shareholders will by-and-bye be asking reasons for it. They may also ask whether the absurdly incompetent management of the United Telephone system is due to lack of intelligence on the part of the board of directors as a body, or to the fact that the managing director gives to the affairs of the company only that small portion of his time that he can spare from his own business at Liverpool. Yesterday it was not enough for the telephone company to have its own wires in a muddle; but in mending them the wires of the Stock Exchange Company were "interfered with," and in many offices "tickers" as well as telephones were on the sick list. "Considerate forbearance" for such a state of things will be rather grudgingly given we suspect. The United Telephone Company should be a public benefit, not a public nuisance.

The Commercial Cable Company. — The second anniversary of the establishment of the Commercial Company was celebrated in a characteristic manner by Mr. Mackay: he gave each of the company's employés a Christmas present of half a month's salary.

Beating Time.—Electricity has in its time played many parts, but to apply it to a conductor's baton has, at any rate, the superior merit of novelty. After the recent manœuvres of the German army, a serenade was given in honour of the Emperor, and 1,200 executants took part. It was pitch dark, and, of course, quite impossible for the bandsmen to see the conductor's beat. But science suggested an accumulator on the music desk, connected with a properly-covered wire secured along the conductor's stick, from the tip of which there shone a tiny electric light.

The School of Electrical Engineering.—After the Christmas examination for the final Vellum Certificate of this school, a very satisfactory report was received by the managers, Messrs. Wm. Lant-Carpenter and L. Drugman, from the external examiner in electrical subjects, Mr. H. R. Kempe, of the Engineer-in-Chief's office, G.P.O. Out of 18 students who presented themselves from the class of the senior instructor, Mr. H. D. Wilkinson, the certificate was awarded to 8, whose *average* percentage of full marks was 91 per cent. in the theoretical questions and 95 per cent. in the practical ones. No certificate is awarded for less than 70 per cent. in each case. The names and marks percentages of the successful students in electric lighting and power transmission are:—A. G. Sanders, 99·3; A. E. Levin, 98·0; C. Mott, 94·7; W. L. Copp, 93·3; F. A. Harris, 92·0; W. F. Collins, 91·3; E. Payne, 81·3. In electric and submarine telegraphy and telephony, B. Brown, 87·3. The first seven students having previously passed the examination in the course of lectures on mechanical engineering, receive the full certificate of the school, which, we may add, now numbers 55 pupils. A steam engine will very shortly be added to the apparatus used in the school. Arrangements have also just been completed whereby, in addition to the course of practical instruction in the school itself, advanced pupils will have the opportunity of gaining actual experience by spending a portion of their time in the workshops of Messrs. Swete and Main, electrical engineers, Kensal Road, W.

The Stirring of the Pool.—The French Cable Company has withdrawn from the pool arrangement which has existed for several years between the several cables (with the exception of the Mackay-Bennett) crossing the Atlantic. The other parties to the arrangement object to this summary procedure, and lengthened litigation is anticipated.

Collision between Steam Trams.—Owing to the prevalence of fog at Heywood on Monday, two steam trams came into collision at Bury Road. One of the engines was much damaged, but the other escaped with slight injuries. No passengers were hurt.

The Electrical Transmission of Power.—Our readers who have followed in the pages of the REVIEW the various stages of the development of M. Marcel Deprez's labours which culminated in the Creil-Paris experiment, will certainly follow with no less interest the recent experiences of M. Fontaine. M. Hospitalier, who, not without reason, has always shown a marked distrust of the results obtained by M. Deprez, seems equally dubious as to the suitability of natural forces to make the electrical transmission of power economical. The editor of *La Nature*, on the contrary, believes that the problem of the utilisation of the forces of nature by means of electricity, is nearer to a practical solution than M. Hospitalier thinks, but expresses the opinion that the numerous discussions to which this question has given rise can only be definitely answered by the future.

Improved Prospects in Engineering.—The half-yearly engineering trades' report, issued by Messrs. Matheson & Grant, 32, Walbrook, states that the year just closed has been one of the worst ever experienced in the engineering trades, but in several branches a slight improvement has set in which bids fair to continue, and the prospects for the coming spring are brighter than they have been for the last two years.

A "New" Arc Lamp.—The Brussels correspondent of *Industries* asserts that the Société Industrielle d'Electricité is manufacturing a new arc lamp, invented by M. Desson, in which the feed motion is controlled by a tiny electro-motor, the armature of which is about 1 inch in diameter. Edison adopted precisely this device for regulating the feed many years ago, so that the novelty of M. Desson's invention is purely fanciful.

Threatened Companies.—Amongst joint stock companies called upon to show cause why they should not be dissolved are the Electric Ships' Lighting Company, the General Telephone Agency Company, and the West Riding Telephone Exchange Company.

The Poor "Great Eastern."—Yet another project to degrade the *Great Eastern!* An enterprising promoter, we are informed by the *Financial News*, proposes to buy the vessel, fit her up in luxurious style, anchor her three miles off Brighton, and use her as a sort of gigantic Monte Carlo.

Electro-Motor Prize Competition.—*Industries* announces that within the last month, and especially during the few days preceding the date on which the entry list was closed, a very large number of designs for electro-motors, in accordance with the regulations laid down for its prize competition, were received. These designs were sent not only from the home countries, but from Germany, Austria, Spain, France, the United States, South America, and even from Norway. "The fact that so many electricians in various parts of the world," says our enterprising contemporary, "have taken the trouble to prepare careful designs for competition, proves not only that they recognise the importance of obtaining a good electro-motor, but also that our conditions were not so difficult as to discourage electrical engineers from attempting to solve the problem we put before them."

Obituary.—Mr. William Edmund Rich, of the firm of Easton & Anderson, of Whitehall Place, London, and Erith, Kent, died, from brain fever, on December 22nd last. Mr. Rich will be remembered by electricians for his able report of tests which he made, in conjunction with Prof. Kennedy, of the Davey-Paxman engines used in driving the electric light installation at the Colonial and Indian Exhibition, and which was published in the REVIEW for November 26th, 1886.

Paris Laboratory.—The Minister of Posts and Telegraphs has lately appointed M. de Nerville as director of the new Central Laboratory of Electricity. Nothing has yet been decided as to the organisation of this institution; a special committee is engaged in discussing the various details. It is probable that the laboratory will be chiefly devoted to the testing, gauging, and correction of instruments employed in electrical measurements.

Continuous Current Transformers.—Writing to *Industries*, Messrs. Paris and Scott say:—"We beg to forward you a copy of our patent, No. 6,260, dated 10th April, 1884, in which we claim the arranging of transformers in parallel, so that they are independent of one another. Our experiments with a 50 light transformer, some two years ago, proved to be so satisfactory that we have decided to light some of the outlying buildings in the grounds of the forthcoming Newcastle Exhibition by means of transformers, in order to demonstrate their practical utility and to allow the profession a full investigation of the system. We believe it will serve the interests of electric lighting better, to show in this way what can be done, rather than rush into print, making statements of efficiency, even if supported by the names of well-known electricians. Too much of this sort of thing has been done lately, benefiting company promoters, to the loss of the public, and damaging the electric lighting industry."

The Telegraph Wires not the Cause.—Robert Chapman, the beadle of Nelson Square, Blackfriars Road, had been to Bristol to spend Christmas. Starting for London again on the night of the historical 26th December, his train was snowed up on Monday morning between Reading and Slough, and the passengers were requested to change to another train. Walking along the line Chapman caught his foot in some broken telegraph wires and poles which had been blown down, and fell, cutting his forehead. Upon reaching London he was able to resume his duties, but after two or three days he was taken ill; and he died on Wednesday last week. Dr. Smith stated at the inquest that he did not attribute death to the lacerated wound on the forehead but to congestion of the lungs arising from exposure to the cold in the early morning of the 27th ult. Verdict accordingly.

Secondary Generator Patents.—In reference to a pending action between Messrs. Gaulard and Gibbs and Mr. Ferranti, an application for the delivery of further particulars of objection was heard before Mr. Justice North on Tuesday last. In the case of one or two objections the learned judge made an order for more specific particulars, and also ordered that the action should be put in the cause list as a witness action and not be heard upon affidavit as was desired by counsel for Mr. Ferranti.

Underground Telegraphs.—The Vienna correspondent of the *Standard* telegraphing on Monday night stated that the Director of the Austrian Telegraphs had told him that underground wires had not been found necessary in Austria, although snowstorms are much more frequent than in England. The overhead wires work excellently, but in Vienna, Prague, and Brünn they were found inconvenient as impeding the traffic, and have therefore been replaced by cables, as also in the Arlberg Tunnel.

An Ebullition of Gas.—At the last meeting of the Balloon Society, Mr. A. H. Le Fevre moved "That this meeting offers its very sincere sympathy to Lady Bolton on the untimely decease of Colonel Sir Francis Bolton, C.E., a member of this society, and the founder of the Society of Telegraph Engineers and Electricians." General Brine seconded the motion, which was carried unanimously. Mr. Moy, C.E., then lectured on "The Electric Telegraph," and in the course of his remarks he condemned the use of overhead wires; where they are used, he said, more supports should be erected and shorter lengths of wire should be employed. Underground wires were expensive and caused great trouble when it was necessary to find out the position of a fault. He suggested a middle course, that of suspending the wires by ornamental supports attached to houses about 20 feet from the ground. He also stated his belief that some day it would be found that gravitation was closely allied to electricity, and he propounded the idea that the revolutions of the planets were analogous to the action of a dynamo, and that the various fields and currents in which the planets revolved, and by which they were interlaced, would possibly produce that mysterious force which was called gravitation. At the close of the lecture Mr. J. Fitzgerald moved, "That this meeting most earnestly desires to call attention to the deplorable and unsafe condition of the electric communication in this country by overhead wires, and hopes that members of Parliament of all shades of opinions, will call upon the Government to take such measures as will prevent the alarming disarrangements that have occurred recently from being repeated, both in the interest of the State and the safety of individual lives; and that a copy of this resolution be sent to the Postmaster-General." This was seconded by General Brine, and carried.

Electrical Smelting.—The Cowles Electric and Smelting Aluminum Company at Lockport, N.Y., has recently placed an order with the Brush Electric Company for three more large dynamos to be used in smelting. Of the aluminum bronze which they are now making Mr. Cowles says:—"It is probably twice as strong as cast steel and stronger than rolled steel by nearly half. Another practicability of this metal, aluminum bronze, is the fact that it can be forged the same as steel or wrought iron, and will no doubt revolutionise the manufacture of large and small guns. The great drawback to the general application of this metal has been its costliness in the past, but by this method it is greatly reduced. But recently aluminum cost from $12 to $14 per pound troy weight, thus making it as costly as silver. By the Cowles process of extraction we have reduced the price, so that the actual cost per pound avoidupois is $2.92."

The Reis Telephone.—An article appears in the new year's number of the *Journal of the Franklin Institute* entitled "Can the original Reis telephones transmit intelligible articulate speech?" In the REVIEW for July 9th we reproduced a paper from the pen of Professor Edwin J. Houston, giving some additional facts concerning the Reis articulating telephone. This has had the effect of calling forth correspondence from Dr. Theodore Stein, who questions the possibility of transmitting speech by the use of the original apparatus which is alluded to in the above-mentioned paper of Prof. Houston's. We shall doubtless refer more fully to this matter in our next.

The Union Electrical Power and Light Company.—With reference to the batteries introduced by this company, the following advantages are claimed:—1. The negative plates are composed of a homogeneous material capable of setting into an extremely hard and durable substance, possessing great porosity and conductivity, and requiring no metallic framework to hold it together. 2. The conductor belonging to each plate is so protected and arranged as to prevent its oxidation. 3. The common defects of buckling and

short circuiting are entirely avoided. 4. Each plate, both negative and positive, can be removed singly from the cell containing it, examined, returned to the cell, or replaced by another, while the battery is at work, without interfering with the charging or lighting which may be in operation. 5. The negative plates can be charged at the works, laid aside dry, and transported any distance, without losing their charge. 6. The positive plates can be similarly charged, and kept or transported in plain water. 7. When the said plates are placed in cells containing dilute acid they will be found to be fully, or nearly fully charged, and capable of giving out over 99 per cent. of the current originally charged into them. 8. When exhausted they can either be recharged by a dynamo on the spot, or can be returned to the works, and be replaced by others fully charged as before. 9. In the latter case they may be said to form primary batteries, free from consumption of zinc or other expensive material. 10. In the former case, they are storage batteries in the ordinary sense of the term. 11. There is no waste from local action; hence the charge may be left in for a long period, or be withdrawn by slow degrees, with practically no loss of efficiency. 12. The batteries are lighter for the same capacity than any other form of battery. It is stated that several cells made under this system have been in use for a considerable time at the General Post Office, and have been pronounced to be more efficient than any other. Prof. George Forbes, in reporting on this battery, says: "It is, I think, the only one I have seen which could, at present, be successfully adopted by a company desirous of supplying the electric light to consumers who do not wish to set up machinery." With reference to the foregoing we would draw attention to the letter of Mr. J. S. Sellon which appears in our present issue, and we may add that the cells in the G.P.O. have been used for telegraphy only.

Society of Telegraph-Engineers and Electricians.—The presidential address of Sir Charles Bright, delivered last night, is specially interesting upon historic grounds, and is intended as a *resumé* of the progress of the telegraph from the days of its first application, 50 years ago, to the present year of Jubilee. We are unable, in consequence of the late arrival of the proof copy, to print the address this week.

Personal.—Mr. T. Carlarr Martin, who recently retired from the East Scottish Engineering Staff of the Postal Telegraph after a period of 16 years service was on the 30th ult. presented with a library of historical and political works—67 volumes in all—as a mark of esteem and respect by his brother officers.

Mr. Bennett, of the *New York Herald* and the Commercial Cable Company, and Mr. Cyrus Field, of the *New York Mail and Express* and the Anglo-American Cable Company, have been inter-changing apologies and professions of undying good-will through the medium of their respective papers.

Mr. T. A. Edison, according to a telegram from Philadelphia, is reported to be seriously ill.

The Dangers of Gas Lighting.—Just after midnight, on Sunday morning, the Rev. James O'Neill, vicar of St. Mary's, Luton, noticing a smell of gas went to inspect the meter; the moment he opened the door of the compartment in which it was kept a terrific explosion occurred, the lamp he held in his hand was shattered, and he himself was so much injured that he was unable to officiate at the usual Sunday services. Scarcely a window in the house escaped damage, and the pantry and plate room were completely wrecked.

A gas explosion last week at 89, Watling Street, City, upon the premises of Messrs. Lowry, Appleby and Jose, warehousemen, resulted in the wrecking of the back and front rooms on the first floor, the blowing out of a window on the second floor, and other damage.

It is stated that the evidence taken by the Military Court of Inquiry into the explosion at the Portsmouth Barracks on the 2nd inst. proves beyond all doubt that the catastrophe was caused by an escape of gas from the main, which was laid down more than 30 years ago, and which, when inspected, was found to be in a very faulty condition. The gas has been shut off at the Cambridge Barracks, and the accident has drawn an order from the Admiralty that the whole of the mains in the dockyard shall be surveyed.

Ten persons were injured at Glasgow on Sunday night by a gas explosion in a tenement of single apartments. The two walls of the common passage were blown in, all the windows of the lower flat were blown out, the floors were torn up, and the furniture was smashed.

The Snowfall and Overhead Wires.—At the last meeting of the Metropolitan Board of Works it was stated that the matter of the fall of overhead wires had been referred to the Government, and the board could do nothing. Mr. Middlemas moved that the subject be referred to the Works Committee for consideration and report. Mr. Shepherd seconded the motion, adding a suggestion that the engineer be called upon to report as to the effects of the snowstorm on the overhead wires of the metropolis.

Writing to the *Times* upon the subject of underground wires, Mr. R. S. Culley says:—"It may be forgotten that more than 30 years ago a large experiment was tried here on underground wires. One system was laid along the London and North-Western Railway—London to Manchester, Liverpool and Leeds; another along the high road—London to Carlisle. Of this second line I know little, but I was in charge of the maintenance of the first. Neither worked more than about five years, although the greatest care was used in their construction. Doubtless these total failures, combined with the greatly increased cost of buried wires and the effect of induction in retarding the speed of our very rapid systems, which is much more than 'a little,' may have had their effect in preventing or delaying the construction of the underground system you so ably advocate. Dr. Stephan's remark to your correspondent may have referred to hand signalling on the Morse system, where the retardation is not great."

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Gülcher Electric Light and Power Company, Limited.—The annual return of this company made up to the 3rd inst. was filed on the 10th inst. The nominal capital is £150,000 in 30,000 shares of £5 each. 19,517 shares have been allotted and the full amount has been called thereupon. The sum of £68,220 has been received in respect of 13,644 ordinary shares, and 5,964 shares allotted to the vendor are considered as fully paid. Upon 162 shares forfeited the sum of £542 10s. 0d. has been paid.

New Telephone Company, Limited.—The annual return of this company made up to the 1st inst. was filed on the 7th inst. The nominal capital is £120,000 in £5 shares. 3,000 shares have been taken up, and upon 2,000 of these the sum of £2 10s. per share has been called up, the remaining 1,000 shares being considered fully paid. The calls paid amount to £4,955 and unpaid to £115. Registered office, 4, Great Winchester Street, E.C.

Electric Locomotive and Power Company, Limited.—The annual return of this company made up to the 1st inst. was filed on the 6th inst. The nominal capital is £60,000 in £5 shares. The number of shares taken up is 8,639 ordinary and 1,354 deferred. Upon 50 shares the full amount has been called up, £3 6s. 8d. per share has been called up upon 4,061 shares, £3 per share upon 64 shares, and £4 per share upon 12 shares. The calls paid amount to £14,026 13s 4d. The sum of £29,000 is considered as paid upon 5,800 shares, and the sum of £6,768 6s. 8d. as paid upon 4,061 shares. Registered office, 6, Great Winchester Street.

John Kirkaldy, Limited.—The registered office of this company is at 40, West India Dock Road.

DEFUNCT COMPANIES.

The following companies, not having complied with the requirements of the Companies Acts, have been struck off the register in pursuance of s. 7 (3) of the Companies Act, 1880 :—

European and American Telegram Company, Limited.—This company was registered on the 13th November, 1878, with a nominal capital of £15,000 in £10 shares to acquire the business of telegraph agent carried on by Otto Rochs, at 2, 3, 4 and 5, Finch Lane, E.C. The only return filed by the company is made up to the 25th March, 1879. At that date 87 shares had been allotted, and the full amount had been called thereon. The calls paid amounted to £520 and unpaid to £350.

National Electric Light Corporation, Limited.—This company was registered on the 8th November, 1878, with a capital of £500,000 in £10 shares, to purchase a certain invention for improvements in the production and application of electric currents for lighting and other purposes, for which a patent had been obtained by John Rapieff. A return made up to the 22nd March, 1879, was filed on the 6th May, 1879. This document shows that beyond the seven shares taken by the signatories to the memorandum and articles of association, no capital had been subscribed.

Universal Telephone Company, Limited. — This company was registered on September 4th, 1885, with a capital of £400,000 in £1 shares to acquire the British and Foreign patent rights of Kazimir Stanislas Dembinski, of Brussels, for improvements in microphones and electrical apparatus for the transmission and reproduction of sound. The company has never raised any capital nor done any business, and the only shares recorded as taken up, are the seven subscribed for by the signatories to the memorandum and articles of association.

CITY NOTES.

German Union Telegraph Company, Limited.—The dividend for the year ended December 31st., 1886, on the 5½ per cent. original preference shares, and an interim dividend of 4 per cent. upon the original stock, being 16s. 6d. on the preference shares (coupon No. 5) and 11s. 9d. on the ordinary stock (coupon No. 6) are payable at the London Agency, Winchester House, 50, Old Broad Street. An interim dividend of 5s. 9d. per share, free of income tax, is announced, payable on the 14th inst.

The Eastern Telegraph Company, Limited.—The directors announce the payment on January 15th of interest at the rate of 3s. per share on the preference shares, less income tax, for the quarter ended December 31st. On the same day an interim dividend will be paid of 2s. 6d. per share, in respect of profits for the quarter ended September 30th, on the ordinary shares, tax free.

Direct United States Cable Company, Limited.—The directors have resolved upon the payment of an interim dividend of 2s. per share free of income tax, being at the rate of 2 per cent. per annum, for the quarter ending December 31st, 1886, such dividend to be payable on and after the 22nd inst.

West African Telegraph Company, Limited.—A quotation has been applied for in the 5 per cent. mortgage debentures in lieu of scrip.

National Telephone Company, Limited. — A call for £1 per share on the second preference stock has been made payable on the 31st. inst.

The West Coast of America Telegraph Company, Limited.—The directors have declared an interim dividend of 2s. per share.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending January 7th were £2,762 after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

NEW PATENTS—1887.

171. "Dynamo and other such like machines." H. C. GOVER. Dated January 6.

187. "Dynamo-electric machines with slotted armatures." G. HOOKHAM. Dated January 6.

188. "Fire telegraphs." W. E. HEYS. (Communicated by J. W. Frost.) Dated January 6. (*Complete.*)

205. "Electrical communicating apparatus applicable for use in navigable vessels." W. CHADBURN. Dated January 6.

211. "Telephonic apparatus." STANHOPE COMPANY, G. L. ANDERS. Dated January 6.

213. "Tubular receivers or pipes for the reception of underground telegraph lines, &c." J. AIRD. Dated January 6.

216. "Combining an electric lamp with a table, said lamp being removable." R. E. HENRY. Dated January 6.

225. "Electro-dynamometers applicable to the construction of electric energy meters." S. PITT. (Communicated by J. Cauderay.) Dated January 6. (*Complete.*)

230. "Filaments or incandescent burner for electric glow or incandescent lamps; preparing same." J. I. RYDER. Dated January 7.

254. "Electrical communicating apparatus; pneumatic and other like communicating apparatus." W. CHADBURN. Dated January 7.

266. "Electric telegraphs." E. EDWARDS. (Communicated by D. Kunhardt.) Dated January 7.

275. "Effecting the distribution of currents of electricity." R. E. B. CROMPTON, J. H. F. SOLL. Dated January 7.

304. "Treating refractory ores for the extraction of gold, silver, copper or zinc by thermo-hydro-electricity. O. ZADIG, E. FELDTMANN. Dated January 8.

305. "Secondary electrical batteries." O. ZADIG, E. FELDTMANN. Dated January 8.

395. "Induction coils or transformers." C. ZIPERNOWSKI, M. DERI, O. T. BLATHY. Dated June 10.

416. "Method of and apparatus for connecting and supporting overhead and underground telegraph and telephone wires and cables, &c." R. W. HALE, J. F. SWANN. Dated January 11.

429. "Telephone till collectors." C. WITTENBERG. Dated January 11. (*Complete.*)

460. "Electrical switching apparatus for telephonic purposes, &c." H. H. LAKE. (Communicated by C. C. Gould and others.) Dated January 11. (*Complete.*)

510. "Single needle telegraphic instruments." J. E. SPAGNOLETTI, J. CROOKES. Dated January 12.

511. "Insulator for wires for electrical and other purposes." J. E. SPAGNOLETTI, J. CROOKES. Dated January 12.

493. "Duplex telephony." A. R. BENNETT. Dated January 12.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1885.

10952. "Improvements in electrical locking apparatus for the working of trains on double and single lines on railways, and for other purposes." C. E. SPAGNOLETTI. Dated September 15. 1s. 1d. The object of this invention is to render it impossible for a signalman on a railway to work a signal (particularly a starting signal) at stations, junctions, or crossings, without the co-operation of the signalman at the block station in advance, who is controlled by the arrival at, or departure of the train from, a given point. To effect this, the inventor mainly employs an apparatus consisting of a key or plunger, which when worked raises a lever bar which is pinioned or hinged at one end, the other end of the said lever bar resting on an armature of an electro-magnet which has two catches at the top of it, one on each side. The claims are 12 in number.

12921. "Improvements in means and appliances for imparting electricity to various parts of the human body." C. BEUST. Dated October 27. 8d. The object of the invention is to effect improvements in means and appliances for imparting electricity to various parts of the human body, such improvements being especially, though not exclusively, applicable to spectacles, the inner soles of boots and shoes, bandages, and other articles to be worn on the person. The claims are 3 in number.

13951. "Improvements in dynamo-electric machines." G. TOLMAN and H. DENTON. Dated November 16. 8d. Relates to the field magnets, armatures, brush holders, and the winding of the magnets and armatures. The field magnet is constructed as follows: A square or rectangular iron base plate with holding down feet, having a pole piece along the centre with an iron arm or support for the iron bearings at the end of the pole piece, screwed on this base plate are two electro-magnets, square or rectangular in shape, placed parallel to the pole pieces, on the top of the said magnets is placed (and screwed down) an iron plate having a pole piece also parallel with and between the magnets, attached to this pole piece and plate is an iron arm for supporting the iron bearings. The claims are 4 in number.

15424. "Improvements in apparatus for measuring electric resistances." O. E. WOODHOUSE, F. L. RAWSON, J. H. DAVIES, and E. J. MOYNIHAN. Dated December 15. 8d. Relates to the apparatus described in the No. of the REVIEW for July 16th, 1886. The claims are 5 in number.

15484. "Improvements in armatures for dynamo-electric machines and motors." J. SWINBURNE. Dated December 17. 8d. Claims:—1. In a gramme or ring armature the method of arranging the connections of the coils, substantially as described, in order to reduce the cross magnetisation of the armature. 2. In a drum armature the methods of winding or arrangement of the wire, substantially as described and shown in the figures. 3. In a drum armature the method of connecting, or arrangement of the connections, to rods across the ends by flat plates of the kind described, substantially as set forth. 4. In a drum armature coupling a group of wires together at one end, and keeping them separate at the other end to avoid Foucault currents, substantially as set forth.

16009. "Improvements in apparatus for measuring electric currents." R. D. SMILLIE. Dated December 30. 8d. Claim:—An improved instrument for the measuring of currents of electricity, in which a current of electricity heats a conductor fixed between two rigid supports and causes it to assume a curved form, greater or less according to the quantity of current flowing through the said conductor, and this curving of the conductor in turn causes movement of an index, as substantially described.

1886.

11693. "Improvements in and relating to telegraphic apparatus." H. H. LAKE. (Communicated from abroad by M. G. Farmer, of New York.) Dated September 14. 8d. Relates to telegraphy and comprises a system or combination of instruments and electric circuits for sending and receiving telegraphic signals by means of induced or secondary currents. The improvements which constitute the invention are a novel arrangement of circuits, whereby a great saving of battery power is effected, and the combination therewith of a circuit closer and circuit reverser by means of which the working of a line is greatly facilitated. The claims are 4 in number.

11823. "Improvements in primary and secondary batteries." P. BAILLY. Dated September 17. 8d. Claims:—1. The special arrangement of a single conductor formed out of the lead plate of the electrode for the purpose of making the connection with the external circuit as described so as to dispense with joints. 2. The manufacture of electrodes from zinc by the amalgamation of fine particles and subsequently moulding the amalgam otherwise than by fusion. 3. The manufacture of receptacles for batteries by placing one vessel inside another and separating them by some material insensible to the action of the acids employed.

12059. "Improvements in certain standards of electromotive force." A. MUIRHEAD. Dated September 22. 6d. Claims:—1. In the construction of standard cells, the use of amalgamated platinum as one of the electrodes, either in the form of a closely wound spiral, or cylinder of wire, or foil preferably grooved or corrugated or with its surface roughened substantially as described. 2. The combination in a standard cell, of platinum amalgamated with pure mercury, and pure zinc as the electrodes with a mixture of pure mercurous sulphate and saturated solution of pure zinc sulphate. 3. The hermetically sealed form of standard cell substantially as above described and illustrated in the drawing accompanying this specification.

CORRESPONDENCE.

Secondary Batteries.

If it is true that imitation is the sincerest form of flattery I have recently had cause to feel highly honoured, so many have been the attempted appropriations of ideas which I have propounded and of claims long since made and published by me in connection with the above subject.

In to-day's issue of your journal I find notice given of a storage cell brought out by the "Union Electrical Power and Storage Company," whose originality of title seems aptly to foreshadow that of their inventions, for a few remarks upon which I crave your space.

I have not seen the "Union" plates, but from your description I gather that they consist as to the negative plates of an agglomerated mass of peroxide of lead fixed in frames or edgings of a "material impervious to acid and indestructible" (evidently of the nature of cellulose), electrical contact being made by means of a strip of platinum. Of their positive plates some reticence appears to be observed.

May I ask you to publish for general information the following epitomised extracts from one of my early patents, No. 5,631, of 1881, being the third taken out by me in that year, in which I describe plates, supports, retainers, or frames of any suitable form for the retention of active material (upon or in which the active material may be fixed or placed in a finely-divided pasty, deposited, or compressed condition), constructed of materials not readily subjected to the destructive influence of oxidation or other destructive action, and specifying, amongst other materials, "cellulose either alone or in combination with platinum, such combination forming a terminal."

My claim runs as follows:—"The construction of terminal plates, supports, retainers or frames employed in secondary batteries of a material not readily subjected to the destructive influence of oxidation, in the manner and for the purpose herein described."

This patent is (as are also the whole twelve taken out by me at various times in connection with secondary batteries) the property of "*The* Electrical Power Storage Company, Limited," who will doubtless speedily call their "Union" namesakes to account for this apparently barefaced piracy of their rights.

With respect to the pretensions put forward by the "Union" Company as to the superiority of their battery over others, I will say little. Upon, presumedly, an imperfect knowledge of what has been done by others, and upon Professorial* tests extending over probably not more than a few weeks (the study of such a form of plate requiring *at least a year* of persistent and careful investigation under varying conditions before a fair report upon it *can be possible*), statements which, in my opinion, must eventually bring ridicule upon those who make them, are put forward of a nature which may, I fear, greatly mislead many of those under whose notice they come.

I can scarcely suppose that the Experts of the "Union" Company have gone through the same experiences as myself in my very natural endeavours to use solid peroxide plates, five or six years ago (embracing various thicknesses, from thin plates of $\frac{1}{8}$ inch up to slabs of $1\frac{1}{2}$ inches, manufactured and worked under all conceivable conditions), otherwise I venture to think they would be somewhat chary of making such assertions as to their advantages, their durability, and their efficiency. I may be answered (as has been stated) that such plates have been put to the proof and have given satisfaction at the Post Office. It would be interesting to know, however, whether their operation has been confined to telegraphic work, for if so, it is little short of childish to put forward such usage as evidence of *how* they will work under the varying and trying requirements of electric lighting and motive power.

I will only further say that if the proportions claimed for their plate by the "Union" Company "of increase of relative amount of *work to weight*," in comparison with the Electrical Power Storage Company's plates, is capable of proof, I shall be the first to congratulate them upon having solved the problem of getting something out of nothing. Their statement on this point appears to me to be nearly on a par with another made by them, viz., the asserted commercial practicability of the systematic replacement of the discharged plates by *slipping in dry plates kept in stock ready charged!!*

Might I ask their Experts to test and publish, the extent to which the hydrogen elements will lose their capacity for work after remaining dry for, say, the limited time of 24 hours, unless zinc is employed, and in such case, what about the cost?

With regard to the Montaud battery, to which you draw attention in the same issue, perhaps those interested in it will inform you how the claim made by M. Faure in his patent, No. 129, of 1881 (the pro

* By the term "Professorial tests," I mean nothing invidious; I use it simply in contradistinction to such practical tests as are obtainable only by commercial and continuous working under ordinary normal conditions such as are impossible upon a laboratory scale.

perty of the Electrical Power Storage Company) is to be got over, viz., for "the process of covering plates with a layer of porous or spongy metallic matter, deposited to any desired thickness by galvanising, chemically precipitating, or mechanical adhesion?" And how about my patents No. 3,987, of 1881, under which I cover the employment of antimony in conjunction with lead, and No. 5,741, of 1883, the six clauses of which provide for so *arranging*, *separating*, and *clamping* the plates as to ensure the all-important points of equi-distance, regularity in working, and the necessary compactness of the sections for ready handling for transport, or for removal from their boxes? It appears to me that every material point put forward in respect of the Montaud battery is covered by the above.

John S. Sellon.

January 8th, 1887.

Electrical accumulators at the present time are exciting so much attention that all interested in them should, I think, contribute what they can to enable them to be better understood by inducing full discussion on all points.

Many are the forms and devices put forward, and many and various are claims of their respective advocates as to durability, efficiency, and freedom from the many vagaries which have yet, apparently, beset their course. It seems to have been proved beyond a doubt that no plates constructed upon the Planté type, with its many modifications, can be of any great practical value for heavy working purposes.

A cell which at the present time appears to be causing a little ripple is the solid peroxide plate form, which may be good for some purposes provided a suitable molecular structure is obtained. The fact of there being little lead or metal of any kind in contact with the peroxide, at first sight conveys a good impression to those whose experience of local action is limited, and I have heard it broadly stated that with such a form of plate perfection in storage cells is an accomplished fact.

Query, is this so, or are not such forms of plates subject to certain disadvantages? The number of those who have had any lengthened experience with them, whether of the fused or agglomerated form, must at the present time be few, and consequently general knowledge on the subject somewhat limited. There are many methods of producing plates of spongy character and of peroxide of lead which are more or less suitable for the purpose required, and which have formed the subject of profit to the Patent Office; but how much is new in any of them?

It cannot be denied that the solid plate under certain conditions may give for a time fairly good results; there is also no doubt that comparatively short usage will develop certain unavoidable defects, leaving out the question of first cost of production, which must be considerable comparatively with those forms in general use. One of its disadvantages is that if the plates are to be durable they must be of great thickness, thus decreasing the efficiency per lb. They must be of small size, as the peroxide plate, if large, will not maintain its shape. In plates of medium thickness, the sulphate formed during discharge will be unequally distributed, decreasing in proportion to the resistance of parts of the plate; that is to say, in proportion to the distance from the metallic attachment or clamp.

We know peroxide in a dense form is a fairly good conductor. We know also that if it is in a desirable form it is not of sufficient conductivity to allow that part of the plate which is some distance from the clamp or conductor to be as active to the charge and discharge as that part which is near to it. This brings about the unequal formation of sulphate alluded to; the more perfect the structure of the plate the greater the effects in this direction, and as a result the plates soon make a graceful curve. If we clamp them tightly in the endeavour to prevent this they crack, which renders some portion comparatively inactive. Many attempts have been made to overcome these faults, but in order to do so the form of plate must be so altered that it can no longer be called a solid slab or plate of peroxide of lead.

The rate of discharge is necessarily limited; if rapid the surface of the plate quickly becomes converted into a lower oxide, followed by much sulphate, thereby increasing the resistance considerably. With plates of the above form, having a suitable structure, say, $\frac{3}{8}$ths of an inch thick 7 inches by 4 inches, a useful capacity of from 4 to 5 ampère-hours per lb. of lead and conductor may for a time be obtained, the rate of discharge not exceeding $\frac{1}{2}$ ampère per lb., whereas with the form of plates now employed by the Electrical Power Storage Company, a capacity of from 7 to 8 ampère-hours per lb. of plate and conductor at the same rate of discharge may be obtained, and at a higher rate of discharge the proportions are under.

Such being the case, apart from the extra cost of production, I fail to see how the solid form of plate now put forward can be considered as an improvement upon those now so well known and proved.

H. A. K.

January 10th, 1887.

Protecting Incandescent Lamps.

On page 647 of your paper for 31st ult., you notice a patent of H. P. Browne, of Chicago, for protecting incandescent lamps in multiple arc groups, which from the description seems to resemble very closely an arrangement made and used by my company some three years ago, a number of which were put up and have since been in use on this installation.

A description of same was given in *Engineering* for January 30th, 1885, on page 105, a copy of which I beg to enclose.

Geo. H. Cottam,

General Representative of the International Electric Company, Limited, Temesvár.

From "Engineering," January 30th, 1885.

"The automatic group cut-out consists simply of an electro-magnet with a coil of high resistance connected up in parallel with the group of lamps it protects. When through the failure of one or more lamps in a group the difference of potential between the terminals of that group increases, a larger current flows through the coils of the electro-magnet and its armature is attracted. The motion of this armature switches in a shunt of suitable resistance between the terminals of the group, and thus affords a passage for the main current independently of the lamps. Two forms of this apparatus have been designed. In one, the lamps of the group are entirely cut out, and, in the other, the undamaged lamps are left in parallel with the shunt, and continue in operation, though with reduced light. These safety appliances have been found to work with great precision."

The Upward Battery.

With reference to "Battery Maniac's" letter in last week's issue, the writer offers the following information:—Soon after bringing out and publishing the Upward battery in its first form as described in the ELECTRICAL REVIEW and other papers (June to August, 1886), the writer conceived and designed a great simplification and improvement in detail, the fundamental principle of course remaining the same; the working out, perfecting, and thoroughly protecting of this has caused the long silence, Messrs. Woodhouse and Rawson having declined all orders, of which they have received many, the largest being a Government order, until the new system was thoroughly ripe.

Three batteries of the early type were sent out, each of which has obtained a certificate of the highest merit from the respective users, both as regards cost of working and all other points claimed. In conclusion, I may say that the new type will very shortly be brought out.

A. René Upward.